

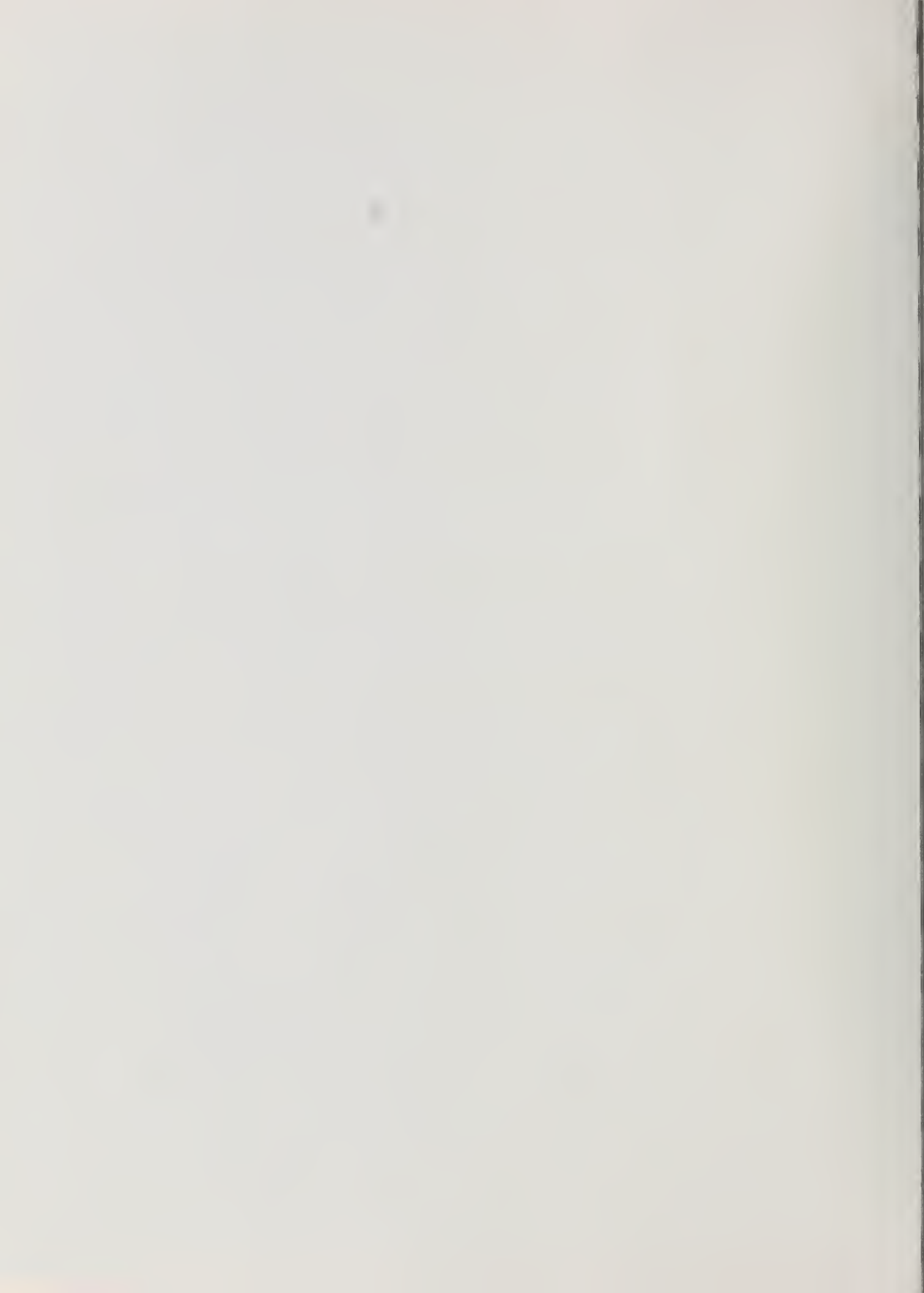
FINAL REPORT

**PERFORMANCE MONITORING OF
RUBBER MODIFIED ASPHALT
DEMONSTRATION PROJECTS**

NOVEMBER 1997



**Ministry
of the
Environment**



November 28, 1997
JEGEL 96023

FINAL REPORT
PERFORMANCE MONITORING OF
RUBBER MODIFIED ASPHALT
DEMONSTRATION PROJECTS

For

WASTE REDUCTION BRANCH
ONTARIO MINISTRY OF ENVIRONMENT

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ABSTRACT

In 1996 and 1997, a program of detailed performance monitoring (consisting of visual inspections, distress surveys, deflection and frictional properties testing, and pavement profile measurements) of twelve rubber-modified asphalt (RMA) pavement projects completed in Ontario was conducted by John Emery Geotechnical Engineering Limited, Consulting Engineers (JEGEL) on behalf of the Ontario Ministry of Environment (MOE). Visual inspections only were completed for an additional twelve projects that were constructed in 1993. The purpose of this performance monitoring was to assess the Ontario RMA projects and compare their performance with conventional pavements and each other to determine the performance benefits attributable to the various RMA technologies, and provide recommendations for future RMA pavements in Ontario.

While it is still relatively early in the life of the RMA demonstration sites, it is clear that 'dry process' RMA sections are deteriorating at a faster rate than conventional asphalt pavements and 'wet process' asphalt rubber (AR) sections. Recent 'moist process' RMA trials constructed using finer crumb rubber modifier are performing better than the dry process sections and comparably to conventional pavement. Terminal blend AR sections are performing similar to or slightly better than conventional pavements. All of the RMA processes appear, at this relatively early point in the pavement life, to be significantly more costly than conventional pavements; extension of the current monitoring program will assist in substantiating the relative performance benefits for RMA life cycle costing.

CHAPTER IV

The first of these is the question of the nature of the state. It is a question which has been discussed in many different ways, and it is one which has not yet been completely settled. The second question is the question of the nature of the law. It is a question which has also been discussed in many different ways, and it is one which has not yet been completely settled. The third question is the question of the nature of the government. It is a question which has also been discussed in many different ways, and it is one which has not yet been completely settled. The fourth question is the question of the nature of the society. It is a question which has also been discussed in many different ways, and it is one which has not yet been completely settled. The fifth question is the question of the nature of the individual. It is a question which has also been discussed in many different ways, and it is one which has not yet been completely settled. The sixth question is the question of the nature of the community. It is a question which has also been discussed in many different ways, and it is one which has not yet been completely settled. The seventh question is the question of the nature of the nation. It is a question which has also been discussed in many different ways, and it is one which has not yet been completely settled. The eighth question is the question of the nature of the world. It is a question which has also been discussed in many different ways, and it is one which has not yet been completely settled. The ninth question is the question of the nature of the universe. It is a question which has also been discussed in many different ways, and it is one which has not yet been completely settled. The tenth question is the question of the nature of the God. It is a question which has also been discussed in many different ways, and it is one which has not yet been completely settled.

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**FINAL REPORT
PERFORMANCE MONITORING OF
RUBBER MODIFIED ASPHALT DEMONSTRATION PROJECTS**

EXECUTIVE SUMMARY

In response to the Ministry of Environment (MOE) detailed Request for Proposal Terms of Reference and briefing meeting of February 5/96, a John Emery Geotechnical Engineering Limited, Consulting Engineers (JEGEL) team was assembled to carry out a program of performance monitoring over a two-year period (in 1996 and 1997). An Interim Report of the Phase 1 monitoring was submitted on July 31/96; this Final Report presents the results of the Phase 2 performance monitoring, and synthesis of the Phase 1 and Phase 2 data in order to develop conclusions and recommendations pertaining to Ontario use of rubber-modified asphalt and asphalt rubber.

The study objectives identified in Section 1.2 of this report have been addressed in accordance with the requirements in the Terms of Reference.

Twelve projects were identified for detailed performance monitoring, with twelve additional demonstration projects in 1993 without any coordinated monitoring identified for visual inspection (to determine their current condition).

Although obvious differences exist between the condition of dry and wet process pavements and their respective performance, with the wet process sections (terminal blend) generally superior, the lack of control sections at each demonstration trial site and current laboratory test data makes it difficult to fully verify the technical merits of one process over the other. The demonstration site selection and pre-engineering in most cases were not carried out to permit direct comparisons to be made, and hence only general comparisons can be made based on the occurrence (or not) of observable distresses that can be directly attributed to rubber-modified asphalt (RMA) use (such as ravelling). Even so, careful attention to detail is required to distinguish ravelling associated with the use of crumb rubber

modifier (CRM) from ravelling due to natural coarse aggregates and/or mix properties (some Grey County sections, for instance). While the technical literature has suggested that the use of RMA can reduce the frequency of longitudinal and transverse cracking, the lack of control sections makes direct comparisons impossible. Comparisons of the demonstration sections with typical pavement performance curves from American Public Works Association (APWA) certainly indicate that the dry process sections are deteriorating at a faster rate than anticipated for a conventional asphalt pavement.

From the performance evaluations completed to date, and our experience with rubber modified asphalt projects, we can make the following conclusions:

1. the dry process CRM sections exhibit lower Pavement Condition Index (PCI) values and are deteriorating at a faster rate than anticipated for conventional asphalt pavements. The distresses most commonly observed in the dry process CRM pavement sections are loss of aggregate/ravelling, longitudinal and transverse cracking and construction joint cracking;
2. the more recent dry process CRM sections constructed using finer CRM ('moist' process) are performing comparably to conventional HMA pavements and better than coarse CRM dry process trials;
3. the performance of the wet process asphalt rubber (AR) sections is generally better than dry or moist process demonstration trials sections, and similar to or better than conventional hot-mix asphalt (HMA) pavements;
4. for the relatively limited number of wet process sections included in this program, it also appears that the terminal blend wet process sections are performing similarly to or slightly better than conventional asphalt pavements; the performance of terminal blend processes also appears to be better than on-site blend processes; and
5. there appears to be a significant additional cost associated with AR and rubber-modified asphalt concrete (RUMAC) technology. Costing information from the Park Road North, Brantford demonstration trial suggests that large scale use of AR mixes with growing contractor experience, will result in a cost for AR mixes about 20 percent greater than conventional HMA. The cost of 'moist process' (essentially dry process RUMAC using finer CRM and longer mixing time) is approximately 40 percent greater than conventional HMA based on Town of Kirkland Lake demonstration trial data.

It must be recognized that virtually all of the demonstration sections are less than 5 years old (in particular, the wet process sites), and as this is still quite early in the pavement service life, the actual performance may differ significantly from that predicted. For the relatively limited number of wet process sections included in this program, it appears that the terminal blend wet process sections are performing similarly to or slightly better than conventional asphalt pavements.

It is recommended that consideration be given to extending the performance monitoring program for selected demonstration sites, with inspections repeated on a biannual basis to determine if the rate of deterioration for each section continues at the predicted rates. The future evaluation of the demonstration sites should be expanded to include coring and laboratory testing to determine the physical and rheological properties of the CRM asphalt. This testing should assist in confirming the visual distress manifestations and in particular, the low temperature properties of the RMA mixes. In addition to visual surveys of pavement distresses, core sampling and laboratory testing should be carried out to confirm Marshall properties, asphalt cement recovery and testing (penetration, viscosity, etc.), and resilient modulus, uniaxial creep and fatigue characterization, using the JEGEL Nottingham Asphalt Tester (NAT).

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**FINAL REPORT
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RUBBER MODIFIED ASPHALT DEMONSTRATION PROJECTS**

1. INTRODUCTION

1.1 BACKGROUND

The Ontario Ministry of Environment (MOE) has sponsored some 33 rubber modified asphalt (either 'dry process' or 'wet process') demonstration projects since 1990, encompassing some 135 kilometres of roads across Ontario, and using nearly half a million passenger tire equivalents. It has been nearly four years since John Emery Geotechnical Engineering Limited, Consulting Engineers (JEGEL), in conjunction with ORTECH, completed the "Evaluation of Rubber Modified Asphalt Demonstration Projects" study, which was published in February 1994 on behalf of the Ontario Ministry of Environment (MOE). This consisted of a comprehensive, comparative, with state-of-the-art, fully-documented evaluation of ten rubber modified asphalt ('dry process') demonstration projects (RUMAC) and one asphalt rubber ('wet process') demonstration project (AR) completed prior to 1993, essentially in terms of pavement performance and environmental impacts.

As a result of this independent 1993 JEGEL-ORTECH evaluation, it was concluded that:

1. the pavement performance of dry process RUMAC can be equivalent to conventional HMA provided that care is taken with: CRM incorporated (quality, size and quantity); mix design procedures; and mix production, placement and compaction;
2. the life-cycle cost of RUMAC is not favourable compared to conventional HMA;
3. the pavement performance of wet process AR hot-mix asphalt can surpass conventional HMA;
4. the life cycle cost of AR appears to be favourable compared to conventional HMA for surface course mixes; and

5. the environmental impacts of rubber-modified asphalts are similar to conventional HMA.

As a result, the MOE focus shifted towards wet process technologies for subsequent demonstration projects undertaken in 1994 and 1995.

In response to the MOE's detailed Request for Proposal Terms of Reference and briefing meeting of February 5/96, a JEGEL team was assembled to carry out the necessary performance monitoring over a two-year period (in 1996 and 1997). An Interim Report of the Phase 1 monitoring was submitted on July 31/96; this draft Final Report presents the results of the Phase 2 performance monitoring, and synthesis of the Phase 1 and Phase 2 data in order to develop conclusions and recommendations pertaining to Ontario's use of rubber-modified asphalt and asphalt rubber.

1.2 OBJECTIVES

The performance monitoring of rubber modified asphalt demonstration projects study objectives are described, in detail, in the Request for Proposal Terms of Reference. The study objectives identified by MOE that have been completed in this Final Report are:

1. To acquire, review and summarize information and background data from selected RMA demonstration projects undertaken by MOE in cooperation with MTO between 1990 and 1995;
2. To evaluate and assess the performance of asphalt-rubber and control pavements, including site condition ratings, visual observations, rut depth and crack propagation;
3. To evaluate and assess the performance of dry process technologies (including cryogenic grind, ambient grind and cold in-place recycling) versus wet process technologies used (terminal blend, on-site blend and moist), and to compare them with similar relevant projects in other jurisdictions and with conventional pavement methods;

4. To conduct post-construction performance monitoring (in 1996 and 1997), including standard, annual pavement condition surveys, physical tests and field observations;
5. To provide and document a database and reference for monitoring and evaluating the RMA demonstration projects including, but not limited to, pre-paving surveys, summary of conventional and RMA mix designs, and construction data and miscellaneous factors that impact field performances;
6. To obtain pavement deflection measurements (FWD) for trial sections which feature new conditions and assess structural differences and changes;
7. To record and report required maintenance procedures, if any;
8. To obtain and record any pertinent traffic and environmental data which impact on the performance; and
9. To identify policy/program impediments, if any, to the expanded use of rubber modified asphalt in Ontario.

Twelve projects were identified for detailed performance monitoring (Table 1.1).

Twelve additional demonstration projects were completed in 1993 without any coordinated monitoring; these projects were identified for visual inspection (to determine their current condition), with relevant supporting photographs, as listed in Table 1.2.

1.3 OVERVIEW OF RUBBER MODIFIED ASPHALT TECHNOLOGY [1]

The Ontario Ministry of Environment (MOE) has funded about 30 demonstration projects to evaluate the use of processed scrap tire crumb rubber modifier (CRM) in hot-mix asphalt. These rubber-modified asphalt demonstration projects have focused on rubber-modified asphalt concrete (RUMAC) where the CRM behaves essentially as rubber

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1. Reproduced from Carrick, J.A., Davidson, J.K., Aurilio, V. and Emery, J., Use of Asphalt Rubber, Paper Prepared for Presentation at the Road Construction, Rehabilitation and Maintenance Session of the 1997 XIIIth International Roads Federation (IRF) World Meeting, Toronto, Canada.

aggregate. Typically, 1 to 3 percent relatively coarse (4 or 10 mesh) CRM is proportioned into a batch or drum hot-mix plant and incorporated during mixing of the HMA (termed 'dry process'). There is little CRM modification of the asphalt cement with dry process RUMAC. Only one rubber-modified asphalt cement (AR) demonstration project was completed prior to the 1994 paving season (Highway 400). With asphalt rubber (AR), typically 10 to 20 percent fine (40, 60 or 80 mesh) CRM is blended with asphalt cement at a central terminal or at the hot mix plant. This stable, uniform, reacted blend of CRM and asphalt cement, with reduced temperature susceptibility, is then incorporated as an asphalt-rubber binder during HMA production (termed 'wet process'). A material, process, technology and product schematic for CRM use in RUMAC and AR is shown in Figure 1.1.

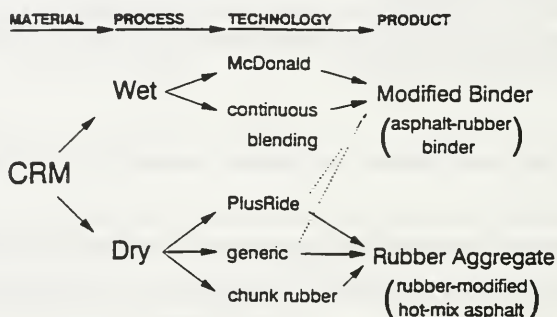


FIGURE 1.1 USE OF PROCESSED SCRAP TIRE CRUMB RUBBER MODIFIER (CRM) IN HOT-MIX ASPHALT (HMA)

(There is some dry process interaction to modify the binder, as indicated by the dotted arrow lines, particularly for finer CRM, extended mixing times or elevated mixing temperatures.)

The McDonald and continuous blending method technologies for asphalt-rubber are considered wet processes, as the CRM is pre-blended with the asphalt cement before AR use in the hot mix plant. This involves reaction of the CRM with hot asphalt cement. An extender oil or catalyst is typically added to ensure CRM dispersion and AR stability against separation or settlement. The AR can be produced at a central terminal or at the hot mix plant. United States proponents of AR technology have favoured using the ambient process

CRM. Ontario experience has been quite satisfactory for cryogenic process CRM. The wet processes are well suited to all hot mix plant operations since the AR can be readily added using the plant's asphalt cement system. Adequate storage stability of the AR is imperative.

There is now an American Society for Testing and Materials (ASTM) proposed standard specification for asphalt-rubber binder (ARB). This comprehensive specification describes asphalt rubber (AR) as a blend of asphalt cement, ground recycled tire rubber (CRM) and other additives. The CRM component must be at least 15 percent by mass of the total blend and 'interacted' in the hot asphalt cement sufficiently to cause swelling of the rubber particles.

The use of AR in HMA requires about 20 percent more ARB than is used in comparable conventional HMA. However, thicker films of ARB in the mix do contribute to improved durability, particularly for open-graded mixes. The AR's lower temperature susceptibility provides increased resistance to permanent deformation and thermal cracking. From an engineering and applications viewpoint, it appears that the wet processes are more economical, practical and predictable than the dry processes. The design, production and placement requirements for asphalt mixes incorporating AR have generally been established for some time and can be considered fairly standard.

TABLE 1.1 RMA PROJECTS INVOLVED IN DETAILED PERFORMANCE MONITORING

Site Number and Description		Project Limits	Length (km)	Constr. Date	Process	CRM Type
1	Grey County Road 9	4 km west of Hopeville to 3 km east of Hopeville	6.9	08/95	Wet; Dry; Wet/Dry	Cryogenic
2	Grey County Road 9	3 km east of Hopeville to County Road 8	7.1	10/94	Wet Terminal; Wet On-Site Blend; Dry	Cryogenic
3	Grey County Road 4	Highway 6 to Desboro	11.2	/93	Dry	Combination
4	Grey County Road 13	Highway 4 to Eugenia	2.7	/92	Dry/Cold In-Place	Cryogenic
5	Grey County 12	Highway 6 to Markdale	12.3	11/91	Dry	Ambient
6	Peterborough	Armour Road	1.8	10/94	Wet Terminal	Cryogenic
7	Kirkland Lake	Main Street	0.3	09/94	Modified Dry ('Moist')	Cryogenic
8	Maryborough Sideroad 6	Highway 86 to Concession 3	2.7	11/93	Dry	Cryogenic
9	Northumberland County Road 9	1 km east of County Road 18 to County Road 15	2.7	/93	Wet Terminal	Cryogenic
	Northumberland County Road 18	County Road 74 to 1.7 km north	1.7	/93	Wet Terminal	Cryogenic
10	Haldimand-Norfolk Regional Road 55	Regional Road 9 to Regional Road 20	4.8	10/90	Dry	Cryogenic
	Haldimand-Norfolk Regional Road 9	Villa Nova to Regional Road 70	3.3	10/90	Dry	Cryogenic
	Haldimand-Norfolk Regional Road 9	Regional Road 70 to Regional Road 55	3.8	10/90	Dry	Cryogenic
11	Highway 400	0.6 km north of Highway 89 to 3 km north	0.5	07/90	Wet On-Site	Cryogenic
12	Brantford	Park Road North	0.5	10/94	Wet Terminal	Cryogenic

TABLE 1.2 1993 RMA PROJECTS INVOLVED IN VISUAL INSPECTION MONITORING

Site Number and Location		Description	Length (km)	Const. Date	AADT	Process	CRM Type
1	New Liskeard	Whitewood Avenue/Highway 65	0.76	07/93	9000	Dry	Cryogenic
2	Fort Frances	River Road	0.25	10/93	300	Dry	Ambient
3	Fort Frances	Armit Avenue	0.1	10/93	1000	Dry	Ambient
4	Barrie Township	Mazinaw Lake Road South	1	10/93	100*		
5	Pelham	Roland Road	2.1	11/93	200-300	Dry	Ambient
6	Windsor	Wildwood Drive Beachdale Road Esplanade Drive	0.3 0.5 0.4	11/93	500*	Dry	Cryogenic
7	Wellington County	County Road 2	2.2	10/93	550	Dry	Cryogenic
8	Wellington County	County Road 14	3.4	10/93	700	Dry	Cryogenic
9	Port Colborne	Composting Site	1 ha	11/93	N/A	Dry	Cryogenic
10	Cambridge	Stanley Street	0.5	11/93	200-300	Dry	Cryogenic
11	Bentinck Township	Sideroad 25	3	10/93	500*	Dry	Cryogenic
12	Grey County	County Road 17	4.4	N/A	2000*	Dry	N/A

* Estimated AADT

2. PROJECT METHODOLOGY

2.1 PROJECT TASKS

The various tasks involved in meeting the project objectives were developed for the performance monitoring and assessment program using the Request for Proposal Terms of Reference and the comments provided by MOE and MTO at the briefing meeting. The JEGEL work program for completion of this study was divided into the following integrated tasks:

2.1.1 Task 1: Obtain Existing Projects Information, Review and Summarize

The first task was to obtain, review and synthesize the information and background data for the selected demonstration projects (as listed in Table 1). This information was obtained where possible from MOE and MTO, noting that a significant quantity of information was already present in JEGEL files from involvement in the previous MOE Evaluation of Rubber Modified Demonstration Projects study and three other recent rubber modified demonstration projects undertaken since 1992 (Grey County Road 9 (1992), Main Street, Kirkland Lake (1993) and Park Road North, Brantford (1995)). By completing this ground work at the outset, any areas of poor documentation, or lacking necessary background and construction data were identified and investigated in conjunction with the field monitoring inspections. The results of this Task are presented in Appendices A and B.

2.1.2 Task 2: Conduct Field Monitoring Surveys, Inspection and Testing

Task 2A - 1996 Phase 1 Monitoring

Task 2B - 1997 Phase 2 Monitoring

The Task 2A detailed 1996 Phase 1 performance monitoring of the twelve selected demonstration projects was completed in April-June/96. The inspections were carried out to coincide with the spring thaw period, the time when the pavement subgrade support is theoretically in its weakest condition. The Task 2B detailed 1997 Phase 2 performance

monitoring was repeated during the same period in 1997, noting that the spring thaw was delayed somewhat by inclement (cold) spring weather conditions.

The JEGEL field inspection team consisted of the necessary personnel and equipment to carry out the performance monitoring, as well as to carry out additional testing that was indicated to investigate specific site conditions. Wherever possible, the same pavement technical staff and testing equipment were utilized for both the 1996 and 1997 inspections and testing work. In addition to trained pavement engineering staff and equipment necessary to perform the detailed visual distress surveys, the testing equipment included the Dynatest 8081 high capacity falling weight deflectometer (FWD), Digital Incremental Profiler (World Bank Class 1 device for road profiling, for rut depth determinations on this project), coring equipment (in the event that pavement cores were considered necessary), etc.

Detailed visual condition surveys were carried out at each site by experienced JEGEL pavement engineers for the purposes of calculating the Pavement Condition Index (PCI) in accordance with the American Public Works Association (APWA) PAVER procedure. The APWA PAVER inspection procedures and distress manuals were adopted for the detailed pavement inspections, supplemented by the MTO pavement distress guides and procedures. Each section was divided into sample units about 250 m² in area. Sample units for detailed pavement condition surveys were randomly selected using a stratified random sampling procedure; depending on the total area of pavement involved, between 100 percent (for small sites) and 25 percent (for large demonstration project sites) of the pavement was inspected in detail, with all pavement distresses within each sample unit mapped and categorized by type, level of severity and extent. The APWA PAVER method also adjusts the PCI to account for 'overlap' of distresses. The same sample units selected and inspected in 1996 were re-inspected in 1997, with the distress data compared for the test sections and some of the control sections to assess the rate of deterioration from the 1996 and 1997 monitoring periods.

The visual condition of each section and control area was also photographed during both the Task 2A 1996 Phase 1 and Task 2B 1997 Phase 2 monitoring events for comparative

purposes. A summary of the field monitoring completed for Tasks 2A and 2B is given as Table 2.1.

For the Task 2A 1996 Phase 1 monitoring, falling weight deflectometer (FWD) testing was conducted at 50 m intervals in alternating lanes (effectively every 100 m per lane) at each demonstration site and corresponding control area, with this testing repeated at approximately the same locations for the Task 2B 1997 Phase 2 monitoring program. The FWD testing was completed at three load levels: about 25 kN, 40 kN (coinciding with the single wheel load of a heavy truck), and 50 kN. The dynamic pavement deflections were then normalized for a standard 40 kN load and pavement temperature of 21°C for comparison purposes. The results of the FWD testing are presented in Table 2.1.

Rut depth measurements were also obtained using a Face Construction Technologies Inc. Digital Incremental Profiler (DIPstick) as part of the 1997 performance monitoring. It was determined that little or no rutting was in evidence on the demonstration sites. Frictional resistance testing (portable British Pendulum) was completed in 1997 on the two Northumberland County demonstration sites only.

2.1.3 Task 3: Conduct Visual Inspections of 1993 Demonstration Projects

An experienced pavement engineer conducted the visual condition inspections of the twelve demonstration projects. Project Number 9 (Northumberland County Recycling Pad) was removed from the survey as the site has been closed and decommissioned. Grey County Road 17 was substituted for review. A JEGEL field technician visited each site and carried out pavement inspections to document the condition of each demonstration project and associated control sections. Photographs were taken at representative locations for future reference. JEGEL also met (where possible) with representatives of the respective agencies directly involved (and contractors when necessary) to obtain any additional design and construction information for the database. The complete inspection and testing results for the Task 2 and Task 3 sections for 1996 and 1997 are presented in the Appendices.

TABLE 2.1 PCI AND FWD RESULTS FOR RMA DEMONSTRATION PROJECTS

Site Number and Location		AADT	PCI		Normalized Dynamic Deflection (mm)		Pavement Support Quality
			1996	1997	1996	1997	
1	Grey County Road 9 - 4 km W of Hopeville to 3 km E	200-500			0.36	0.36	Very Good
	Wet Process		100	100			
	Dry Process		100	100			
	Wet/Dry Process		97	96			
	Control		100	100			
2	Grey County Road 9 - 3 km E of Hopeville to County Road 8	200-500			0.36	0.36	Good
	Wet Terminal		98	98			
	Wet On-Site Blend		96	96			
	Dry		87	87			
	Control #1		96	95			
	Control #2		92	88			
3	Grey County Road 4	200-400	84	84	0.34	0.34	Good
4	Grey County Road 13	500-800	97	96	0.24	0.24	Very Good
5	Grey County Road 12	200-400	87	84	0.30	0.31	Good
6	Armour Road, Peterborough	6300	95	94	0.28	0.28	Very Good
7	Main Street, Kirkland Lake	600	96	97	0.52	0.63	Very Good
8	Maryborough Sideroad 6	500	86	85	0.57	0.57	Good
9	Northumberland County Road 9	-	93	92	0.29	0.29	Very Good
	Northumberland County Road 18	-	84	84	0.23	0.23	Good
10	Haldimand-Norfolk Regional Road 55	-	75	74	0.34	0.31	Good
	Haldimand-Norfolk Regional Road 9 - Villa Nova to Regional Road 70	-	84	83	0.38	0.32	Fair
	Haldimand-Norfolk Regional Road 9 - Regional Road 70 to Regional Road 55	-	71	71	0.32	0.31	Fair
11	Highway 400	36000*	-	-	0.06-0.12**	-	Good
12	Park Road North, Brantford	9500	99	85	0.29	-	Good

* For 6 Lanes (1988)

** FWD data from 1990

3. FINDINGS AND DISCUSSION

3.1 GENERAL DESCRIPTION OF FIELD EVALUATION DATA

The evaluations of the Ontario rubber modified asphalt demonstration projects, as reported in detail in the Appendices, were analyzed to develop findings and recommendations pertaining to the performance of wet process (terminal blend, on-site blend and moist) asphalt-rubber (AR) and dry process (cryogenic grind, ambient grind and cold in-place recycling) rubber modified asphalt concrete (RUMAC) technologies. In addition, a computerized database of the detailed monitoring results, including typical photographs, has been prepared and is provided on a separate diskette.

The JEGEL analysis of the performance evaluations was synthesized in the following sections. Of the twelve detailed performance monitoring trials identified by MOE, only two incorporated control sections within the individual trials that enable direct comparisons.

3.2 WET PROCESS DEMONSTRATION SITES

Wet process technologies were utilized on sections of seven sites that were evaluated in detail:

1. Grey County Road 9, 4 km west of Hopeville to 3 km east of Hopeville (terminal blend);
2. Grey County Road 9, 3 km east of Hopeville to County Road 8 (terminal blend; on-site blend);
3. Armour Road, Peterborough (terminal blend);
4. Northumberland County Road 9 (terminal blend);
5. Northumberland County Road 18 (terminal blend);
6. Highway 400, north of Highway 89 (on-site blend); and
7. Park Road North, Brantford (terminal blend).

None of the additional twelve 1993 demonstration projects that were also visually inspected involved wet process technologies.

The most significant observations for each of these test sections are summarized in the following sections, with the overall results then compared to develop conclusions for comparison of wet and dry technologies.

3.2.1 Grey County Road 9: 4 km west of Hopeville to 3 km east of Hopeville

- terminal blend AR, 6.8% (Duratirephalt) in two sections totalling approximately 4.3 km, both lanes (wet process) + terminal blend, 6.8% (Duratirephalt) with 1% cryogenic #10 mesh dry process in one section totalling approximately 1.3 km both lanes (wet/dry process)

One of the wet process sections exhibits low severity aggregate loss (ravelling) throughout, which does not appear to have changed between the 1996 and 1997 inspections. Relatively small quantities of low severity transverse cracking, low to medium severity longitudinal and meandering cracking were also observed in the wet process and wet/dry process and control sections. The distresses do not appear to be directly related to the use of wet process asphalt rubber technologies, but rather reflect the condition of the pavement prior to this rehabilitation work. There is no discernable difference in the deflection performance of the various wet process, wet/dry process, dry process or control sections. The predicted performance of this section of Grey County Road 9, after 2 years of service, compared to that reported by the American Public Works Association (APWA) PAVER manual, is slightly worse, with this pavement section predicted to fall below the terminal serviceability level (60) after about 13 years, compared to 15 years for conventional asphalt pavements. The condition of the wet/dry section is slightly worse than the wet process section and dry process section, but all are in very good condition at this early age.

3.2.2 Grey County Road 9: 3 km east of Hopeville to County Road 8

- terminal blend AR (Duratirephalt) in one section, both lanes, totalling approximately 3.2 km, with on-site blend AR in an adjacent 1.1 km section, both lanes

This section of Grey County Road 9 exhibits throughout, slight aggregate loss that is common to the wet process and control sections (considered to be a function of the coarse aggregate, not RMA use). Some low severity ravelling was observed within the on-site blend section, but not in the terminal blend or control sections. Some low severity edge cracking was observed in the control sections, but not in the AR sections. Conversely, the visual condition of the control and dry process sections is significantly lower, with the dry process section rated as very poor. There is no discernable difference in the deflection performance of the various wet process or control sections. The predicted performance of this section of this section of Grey County Road 9, after 3 years of service, compared to that reported by the APWA PAVER manual, is virtually the same, with this pavement section predicted to fall below the terminal serviceability level (60) after about 14.5 years, compared to 15 years for conventional asphalt pavements.

3.2.3 Armour Road, Peterborough: Parkhill Road to 1.8 km North

- terminal blend AR (Duratirephalt, consisting of 85% 150/200 asphalt cement + 15% cryogenic #60 mesh CRM)

The terminal blend wet process section exhibits low severity longitudinal, transverse and meandering cracking that has only increased slightly between the 1996 and 1997 inspections. There is no apparent difference in the performance of the wet process section or the adjacent control section. There is no discernable difference in the deflection performance of the respective wet process and control sections. The predicted performance of this section of Armour Road, after nearly 2 years of service, compared to that reported by the APWA PAVER manual, is slightly worse, with this pavement section predicted to fall below the terminal serviceability level (60) after about 13 years, compared to 15 years for conventional asphalt pavements.

3.2.4 Northumberland County Road 9: 1 km east of County Road 18 to County Road 15

- terminal blend AR (5.1%, Bitumar Ecoflex, consisting of 90% 85/100 asphalt cement with 10% CRM) in one section, both lanes, totalling approximately 2.7 km

This section exhibits relatively general low severity construction joint cracking, longitudinal cracking, alligator cracking and edge cracking throughout, with localized minor low to medium severity transverse cracking and medium severity meandering cracking. A small amount of ravelling and patching was also noted. Neither the quantity nor severity of the distresses was observed to increase significantly between the 1996 and 1997 inspections. The deflection performance of section is also relatively consistent throughout. The predicted performance of this section of this section of Northumberland County Road 18, after 4 years of service, compared to that reported by the APWA PAVER manual, is slightly worse, with this pavement section predicted to fall below the terminal serviceability level (60) after about 13 years, compared to 15 years for conventional asphalt pavements.

3.2.5 Northumberland County Road 9: County Road 74 North 1.7 km

- terminal blend AR (5.1%, Bitumar Ecoflex, consisting of 90% 85/100 asphalt cement with 10% CRM) in one section, both lanes, totalling approximately 1.7 km

This section exhibits relatively general low severity construction joint cracking, longitudinal cracking, alligator cracking and edge cracking throughout, with localized minor low to medium severity transverse cracking and medium severity meandering cracking. A small amount of ravelling was also noted. Neither the quantity nor severity of the distresses was observed to increase significantly between the 1996 and 1997 inspections. The deflection performance of section is also relatively consistent throughout. The predicted performance of this section of Northumberland County Road 18, after 4 years of service, compared to that reported by the APWA PAVER manual, is significantly worse, with this pavement section predicted to fall below the terminal serviceability level (60) after about 7.5 years, compared to 15 years for conventional asphalt pavements.

3.2.6 Highway 400: 5.5 km North of Highway 89 for 325 m

- on-site blend AR (Rouse Rubber Industries, cryogenic #80 mesh CRM)

After 5 years service, this section is reported by MTO (Polymer-Modified Asphalt Pavements in Ontario: Performance and Cost-Effectiveness, PAV-05-01, Ontario Ministry of Transportation, Research and Development Branch, December 1995) to be performing better than the conventional control mix in terms of rut resistance. However, this section exhibits a higher incidence of longitudinal and transverse cracking that was attributed to age hardening of the asphalt cement. Transverse cracking was observed at regular 20 to 25 m intervals.

Based on the development of wheel-track rutting, the predicted performance of this section, after 5 years service, is somewhat better than that predicted by MTO for the conventional control section, with the critical 19 mm rut depth not expected to occur within 15 years (12 years for conventional control section).

3.2.7 Park Road North, Brantford: Dunsdon Street to Powerline Road

- terminal blend AR (Duratirephalt, consisting of 85% asphalt cement + 15% cryogenic #40 to #60 mesh CRM)

This section exhibits throughout, low severity longitudinal, transverse and meandering cracking, that increased significantly between the 1996 and 1997 inspections. The deflection performance is relatively consistent throughout. The predicted performance of this section of Park Road North, after 3 years of service, compared to that reported by the APWA PAVER manual, is significantly worse, with this pavement section predicted to fall below the terminal serviceability level (60) after about 9 years, compared to 15 years for conventional asphalt pavements.

3.2.8 Synthesis of Wet Process Demonstration Trial Performance

The detailed performance monitoring completed at this relatively early stage of the pavement life indicates that, for the seven sections constructed using wet process

technologies, the relative performance of AR hot-mix asphalt is generally similar to or somewhat lower than that of conventional pavements, as predicted by APWA. The two Northumberland County sites were completed using AR from the same source, and while one appears to be performing comparably to conventional asphalt, the other is performing significantly worse. The most significant distresses within the poor performing section were construction joint cracking and alligator cracking that are not related to AR use. The Park Road North site in Brantford exhibits mainly longitudinal, transverse and construction joint cracking that increased in frequency significantly between 1996 and 1997. While the construction joint cracking is probably not related to AR use, it is not possible to determine without laboratory characterization if the other cracking observed to date is related to AR use or to other pavement distress mechanisms. Only two sites involved on-site blending, and one of these (Grey County Road 9) exhibits more distress than the adjacent section paved using terminal blended AR. Hence, it appears that terminal blend processes are preferable to on-site blend processes.

3.3 DRY PROCESS DEMONSTRATION SITES

Dry process technologies were utilized on sections of ten sites that were evaluated in detail:

1. Grey County Road 9, 4 km west of Hopeville to 3 km east of Hopeville (dry and wet/dry combined);
2. Grey County Road 9, 3 km east of Hopeville to County Road 8;
3. Grey County Road 4, Highway 6 to Desboro;
4. Grey County Road 13, Highway 4 to Eugenia (dry/cold in-place);
5. Grey County Road 12, Highway 6 to Markvale;
6. Main Street, Kirkland Lake (modified dry);
7. Maryborough Sideroad 6, Highway 86 to Concession 3;
8. Haldimand-Norfolk Regional Road 55, Regional Road 9 to Regional Road 20;

9. Haldimand-Norfolk Regional Road 9, Villa Nova to Regional Road 70; and
10. Haldimand-Norfolk Regional Road 9, Regional Road 70 to Regional Road 55.

In addition, all of the twelve 1993 demonstration projects that were also visually inspected involved dry process technologies.

The most significant observations for each of these test sections and 1993 demonstration projects are summarized in the following sections, with the overall results then compared to develop conclusions for comparison of wet and dry technologies.

3.3.1 Grey County Road 9: 4 km west of Hopeville to 3 km east of Hopeville

- HL 4 with 2% cryogenic #10 mesh dry process in one section approximately 0.8 km long, both lanes + an additional section of combined wet/dry process HL 4 with terminal blend, 6.8% (Duratirephalt) and 1% cryogenic #10 mesh dry process in one section totalling approximately 1.3 km in length, both lanes

The dry process section exhibited only a small amount of low severity transverse cracking at the time of the 1996 inspection, with some additional low severity meandering cracks observed at the time of the 1997 inspection. There is also general, very low severity ravelling associated with loss of fine aggregate. Similarly, the wet/dry process section exhibited a slight increase in the amount of low severity meandering cracking between 1996 and 1997. The PCI did not change appreciably in either of these sections. The PCI of the control section, the wet process section and the dry process section are virtually identical (100), with only the wet/dry process section exhibiting slightly lower performance (PCI of 96 after 2 years). Only the general, very low severity ravelling appears to be directly related to the use of dry process asphalt rubber technologies. There is no discernable difference in the deflection performance of the various wet process, wet/dry process, dry process or control sections. The predicted performance of these sections of Grey County Road 9, after 2 years of service, compared to that reported by the American Public Works Association (APWA) PAVER manual, is slightly worse, with this pavement section predicted to fall below the terminal serviceability level (60) after about 13 years, compared to 15 years for conventional

asphalt pavements, and is attributed primarily to the condition of the pavement prior to rehabilitation and the natural aggregates used in the HMA.

3.3.2 Grey County Road 9: 3 km east of Hopeville to County Road 8

- cryogenic dry process in one section, both lanes, totalling approximately 1.0 km

This section of Grey County Road 9 exhibits low severity construction joint cracking for the full length of the section, as well as some low severity edge cracking. As similar cracking was observed at about the same frequency in the control section, neither of these distresses is considered to be related to the use of dry process RMA. There is no discernable difference in the deflection performance of the dry process or control sections. The predicted performance of this section of Grey County Road 9, after 3 years of service, compared to that reported by the APWA PAVER manual, is somewhat poorer, with these dry process and control pavement sections predicted to fall below the terminal serviceability level (60) after about 10 to 11 years, compared to 15 years for conventional asphalt pavements, and is attributed primarily to the condition of the pavement prior to rehabilitation and the natural aggregates used in the HMA.

3.3.3 Grey County Road 4: Highway 6 to Desboro

- construction details not available; combination of cryogenic and ambient ground dry process RMA, in both lanes, totalling 11.2 km

This section of Grey County Road 4 was rehabilitated in 1993 and exhibits low to medium severity construction joint cracking for the full length of the section, as well as low to medium severity edge cracking and longitudinal cracking, and a small amount of low to high severity transverse cracking. Ravelling, patching and potholes were also evident. The quantity of pavement distresses did not change from the 1996 and 1997 inspections, with a PCI of 84 determined after 4 years of service. The deflection performance of this dry process section has not changed between 1996 and 1997. The predicted performance of this section of Grey County Road 4, after 4 years of service, compared to that reported by the APWA PAVER manual, is significantly poorer, with this dry process pavement section predicted to

fall below the terminal serviceability level (60) after about 7 years, compared to 15 years for conventional asphalt pavements.

3.3.4 Grey County Road 13: Highway 4 to Eugenia

- cryogenic #4 mesh dry process added as aggregate using modified cold in-place recycling train; overlaid with conventional HL 4 surface, in both lanes, totalling 2.7 km

This section of Grey County Road 13 was rehabilitated in 1992 and exhibits relatively small amounts of distress including low severity longitudinal, construction joint and meandering cracking, and localized low severity ravelling. Some low to medium severity transverse cracking was also noted. Low severity edge cracking was the only distress type that was observed to increase significantly between the 1996 and 1997 inspections, but this does not significantly reduce the PCI for this section. The deflection performance of this dry process section has not changed between 1996 and 1997. The predicted performance of this section of Grey County Road 13, after 5 years of service, compared to that reported by the APWA PAVER manual, is somewhat better, with this dry process pavement section predicted to fall below the terminal serviceability level (60) after about 18 years, compared to 15 years for conventional asphalt pavements.

3.3.5 Grey County Road 12: Highway 6 to 2.5 km west of Markvale

- ambient #10 mesh dry process added to HL 4 surface course, in both lanes, totalling 12.3 km

This section of Grey County Road 12 was rehabilitated in 1991 and exhibits low to medium severity meandering cracking, alligator cracking and edge cracking, with some low severity transverse and construction joint cracking. The quantities and severity of the alligator cracking, edge cracking, transverse cracking and construction joint cracking appear to have increased significantly between the 1996 and 1997 inspections, though this resulted in only a small decrease in the PCI for the total section. The deflection performance of this dry process section has not changed between 1996 and 1997. The predicted performance of this

section of Grey County Road 12, after 6 years of service, compared to that reported by the APWA PAVER manual, is somewhat poorer, with this dry process pavement section predicted to fall below the terminal serviceability level (60) after about 11 years, compared to 15 years for conventional asphalt pavements.

3.3.6 Main Street, Kirkland Lake: Birch Street to 325 m south

- 1.2% by mass cryogenic #30 mesh modified dry process ('moist') added to HL 4 surface course, in both lanes, totalling 0.325 km

This section of Main Street was reconstructed in late 1994 and exhibits minimal distress, including low severity transverse cracking, and a very small amount of alligator cracking and edge cracking. A localized depression that was observed during the 1996 inspection, has been patched in 1997 resulting in a slight increase in the PCI from 1996 to 1997. The magnitude of the pavement deflections in this dry process section increased slightly between 1996 and 1997. The predicted performance of this section of Main Street, after less than 3 years service, compared to that reported by the APWA PAVER manual, is virtually the same, with this modified dry process pavement section predicted to fall below the terminal serviceability level (60) after about 17 years, compared to 15 years for conventional asphalt pavements.

3.3.7 Maryborough Sideroad 6: Highway 86 to Concession 3

- 1.41% by mass cryogenic #10 mesh CRM dry process added to HL 4 surface course, in both lanes, totalling 2.7 km

This section of Maryborough Sideroad 6 was rehabilitated in late 1993 and exhibits mainly general low severity ravelling as well as low severity transverse cracking, and a very small amount of alligator cracking and edge cracking. A localized depression that was observed during the 1996 inspection has been patched in 1997, resulting in a slight increase in the PCI from 1996 to 1997. The magnitude of the pavement deflections of this dry process section increased slightly between 1996 and 1997. The predicted performance of this section of Maryborough Sideroad 6, after less than 3 years service, compared to that reported by the

APWA PAVER manual, is somewhat poorer, with this dry process pavement section predicted to fall below the terminal serviceability level (60) after about 11 years, compared to 15 years for conventional asphalt pavements.

3.3.8 Haldimand-Norfolk Regional Road 55: Regional Road 9 to Regional Road 20

- cryogenic #10 mesh CRM dry process added to HL 3 surface course and HL 8 binder course, in both lanes, totalling 4.8 km

This section of Haldimand-Norfolk Regional Road 55 was rehabilitated in late 1990 and exhibits a number of distresses, including low to medium severity longitudinal and low to high severity transverse cracking, low to medium severity construction joint cracking, alligator cracking, ravelling and patching. Areas of more severe cracking and ravelling outside of the inspection sample units were noted to have been spray patched. The pavement condition is described as being fair, and does not appear to have changed significantly between the 1996 and 1997 inspections. The magnitude of the pavement deflections of this dry process section did not change between 1996 and 1997. The predicted performance of this section of Haldimand-Norfolk Regional Road 55, after approximately 7 years service, compared to that reported by the APWA PAVER manual, is somewhat poorer, with this dry process pavement section predicted to fall below the terminal serviceability level (60) after about 9 years, compared to 15 years for conventional asphalt pavements.

3.3.9 Haldimand-Norfolk Regional Road 9: Villa Nova to Regional Road 70

- cryogenic #10 mesh CRM dry process added to HL 3 surface course and HL 8 binder course, in both lanes, totalling 3.3 km

This section of Haldimand-Norfolk Regional Road 9 was rehabilitated in late 1990 and exhibits a number of distresses, including low to medium severity longitudinal and transverse cracking, nearly continuous low to medium severity construction joint cracking, medium severity meandering cracking, alligator cracking, ravelling and patching. Areas of more severe cracking and ravelling outside of the inspection sample units were noted, with some of the ravelled areas spray patched between 1996 and 1997. The overall pavement condition is

described as being fair, and does not appear to have changed significantly between the 1996 and 1997 inspections. The magnitude of the pavement deflections of this dry process section did not change between 1996 and 1997. The predicted performance of this section of Haldimand-Norfolk Regional Road 9, after approximately 7 years service, compared to that reported by the APWA PAVER manual, is somewhat poorer, with this dry process pavement section predicted to fall below the terminal serviceability level (60) after about 11 to 12 years, compared to 15 years for conventional asphalt pavements.

3.3.10 Haldimand-Norfolk Regional Road 9: Regional Road 70 to Regional Road 55

- cryogenic #10 mesh CRM dry process added to HL 3 surface course and HL 8 binder course, in both lanes, totalling 3.8 km

This section of Haldimand-Norfolk Regional Road 9 was rehabilitated in mid-1990 and exhibits a number of distresses, including low to high severity longitudinal and transverse cracking, nearly continuous low to medium severity construction joint cracking and meandering cracking, and minor localized alligator cracking and patching. Areas of more severe cracking and ravelling in the wheelpaths outside of the inspection sample units were also noted, with some of the ravelled areas spray patched between the 1996 and 1997 inspections. The overall pavement condition is described as being fair, and does not appear to have changed significantly between the 1996 and 1997 inspections. The magnitude of the pavement deflections of this dry process section did not change between 1996 and 1997. The predicted performance of this section of Haldimand-Norfolk Regional Road 9, after approximately 7 years service, compared to that reported by the APWA PAVER manual, is significantly poorer, with this dry process pavement section predicted to fall below the terminal serviceability level (60) after about 8 years, compared to 15 years for conventional asphalt pavements.

3.3.11 1993 Demonstration Trials

All the 1993 demonstration trial sections that were identified for visual condition surveying only were exclusively dry process projects. Generally, these projects exhibited

distresses in excess of that normally expected for similar asphalt paving projects of equivalent age. As previously stated, most of the visual distresses noted are related to construction defects, or age-related defects, albeit occurring earlier in life than normally expected in asphalt pavements of this type. Load-related damage is not predominant in these generally low-trafficked pavements. It therefore appears that the distresses are more directly attributable to the use of dry-process CRM than to other factors such as traffic and environment-related conditions. Ravelling, or loss of coarse aggregate and/or CRM particles, is a predominant distress.

3.3.12 Synthesis of Dry Process Demonstration Trial Performance

In general, the dry process demonstration sections have been in place for a significantly longer period than the wet process sections, and with the exception of the two Grey County Road 9 sections, no control sections were constructed in conjunction with these demonstration trials. Hence, direct comparison of the pavement condition is not possible. In general, the overall pavement condition is somewhat lower for the older dry process sections, with two of the three Haldimand-Norfolk sections in only fair condition. The recent dry process trials involving finer CRM are performing similarly to the predicted performance for conventional hot-mix asphalt pavements. All of the dry process pavement sections exhibit longitudinal and transverse cracking, and some construction joint cracking, with most also exhibiting ravelling.

The results of non-destructive load/deflection testing using the Dynatest 8081 Falling Weight Deflectometer indicate that the pavement structures are generally sufficient for the traffic loads imposed. The results of this testing, coupled with the results of the visual distress surveys indicate that the distresses observed are the result of construction-related defects or processes rather than from traffic or excessive loading.

While the deflection conditions of the dry process pavements are consistently acceptable, pavement performance nevertheless ranged from somewhat lower to significantly lower than that anticipated for conventional asphalt pavements, as predicted by APWA. The

visual inspections of the 1993 demonstration sites corroborate the above detailed performance monitoring observations.

Overall, the wet process CRM projects have higher PCI values, reflecting the better condition of the wet process compared to the dry process projects.

4. CONCLUSIONS AND RECOMMENDATIONS

Although there are obvious differences between the condition of dry and wet process pavements and their respective performance, with the wet process sections (terminal blend) being generally superior, the lack of control sections at each demonstration trial site and current laboratory test data makes it difficult to fully verify the technical merits of one process over the other. The demonstration site selection and pre-engineering in most cases were not carried out to permit direct comparisons to be made, and hence only general comparisons can be made based on the occurrence (or not) of observable distresses that can be directly attributed to RMA use (such as ravelling). For instance, careful attention to detail is required to distinguish ravelling associated with the use of CRM from ravelling due to natural coarse aggregates and/or mix properties (Grey County sections, for example). The technical literature has suggested that the use of RMA can reduce the frequency of longitudinal and transverse cracking, but the lack of control sections makes direct comparisons impossible. However, from the performance evaluations completed to date and our experience with rubber modified asphalt projects, we can make the following conclusions:

1. the dry process CRM sections exhibit lower PCIs and are deteriorating at a faster rate than anticipated for conventional asphalt pavements. The distresses most commonly observed in the dry process CRM pavement sections are loss of aggregate/ravelling, longitudinal and transverse cracking and construction joint cracking;
2. more recent dry process CRM sections constructed using finer CRM ('moist' process) are performing comparably to conventional HMA pavements and better than coarse CRM dry process trials;
3. the performance of the wet process AR sections is generally better than dry or moist process demonstration trials sections, and similar to or better than conventional HMA pavements;
4. for the relatively limited number of wet process sections included in this program, it also appears that the terminal blend wet process sections are performing similarly to or slightly better than conventional asphalt pavements; the performance of terminal blend processes also appears to be better than on-site blend processes; and
5. there is a significant additional cost associated with AR and RUMAC technology. Costing information from the Park Road North, Brantford demonstration trial suggests

that large scale use of AR mixes with growing contractor experience, will result in a cost for AR mixes about 20 percent greater than conventional HMA. The cost of 'moist process' (essentially dry process RUMAC using finer CRM and longer mixing time) is approximately 40 percent greater than conventional HMA based on Town of Kirkland Lake demonstration trial data.

However, it must be recognized that virtually all of the demonstration sections are less than 5 years old (and the wet process sites in particular), and this is still quite early in the pavement service life. As such, it is recommended that consideration be given to extending the performance monitoring program for selected demonstration sites in order to verify that the rate of deterioration for each section continues at the predicted rates. The following RMA projects are considered to be most appropriate for continued monitoring:

- A1. Grey County Road 9, 4 km west of Hopeville to 3 km east;
- A2. Grey County Road 9, 3 km east of Hopeville to County Road 8;
- A6. Armour Road, Peterborough;
- A7. Main Street, Kirkland Lake;
- A9. Northumberland County Roads 9 and 18 (two sections);
- A10. Haldimand-Norfolk Regional Roads 55 and 9 (three sections); and
- A12. Park Road North, Brantford.

These projects have been specifically identified for the following reasons:

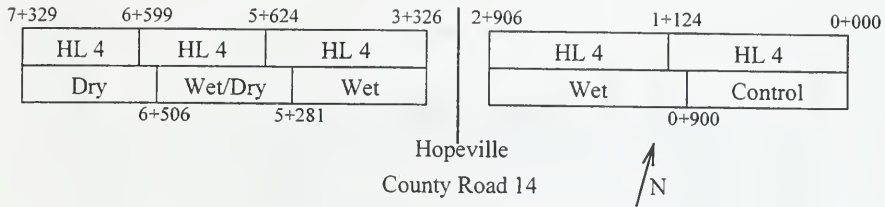
- i. the Grey County Road 9 sections are the only two that have incorporated control sections of conventional asphalt;
- ii. the selected sections represent the full range of processes and mix types used in Ontario;
- iii. the current condition of these pavement sections ranges from very good to fair, and while generally still relatively early in the pavement service life, nevertheless represent a range of pavement ages; and
- iv. the selected pavement sections represent a range of road classifications (rural, urban, etc.) and traffic volumes.

Consideration should also be given to expanding the evaluation program for the demonstration sites to include coring and laboratory testing to determine the physical and rheological properties of the CRM asphalt. This testing would assist in confirming the visual distress manifestations and in particular, the low temperature properties of the RMA mixes. In addition to visual surveys of pavement distresses, core sampling and laboratory testing should be carried out to confirm Marshall properties, asphalt cement recovery and testing (penetration, viscosity, etc.), and resilient modulus, uniaxial creep and fatigue characterization using the JEGEL Nottingham Asphalt Tester (NAT).

APPENDIX A

A1. Grey County Road 9

Location: 4 km west of Hopeville to 3 km east of Hopeville, 6.9 km.



Construction Date: Aug. 24, 25, 28, 1995

Contractor: The Murray Group

Mix types: 45 mm HL 4 overlay

Control: approx. 100 tonnes of padding and 870 tonnes of paving, 5.2% A.C.

Wet: 2800 tonnes, 6.8% A.C. (Duratirephalt)

Wet/Dry: 750 tonnes, 6.9% A.C. (Duratirephalt), 1% #10 mesh

Dry: 560 tonnes, 6.8% A.C., 2% #10 mesh

Distress Summary:

Section / Distress Type	1996			1997		
	Low	Moderate	High	Low	Moderate	High
Control Section						
Longitudinal (m)				120		
PCI		100			100	
Wet Process						
Longitudinal (m)		35			35	
Transverse (m)	7	7		7	7	
Meandering (m)				20		
Ravelling (m ²)	50			50		
PCI		100			100	
Wet/Dry Process						
Meandering (m)	10	100		25	105	
PCI		97			96	
Dry Process						
Transverse (m)	3			3		
Meandering (m)				20		
PCI		100			100	
Overall PCI		96			96	

Rubber Modified Asphalt Detailed Pavement Monitoring Sections
A1. Grey County Road 9 from 3 km east of Hopeville to 4 km west of Hopeville

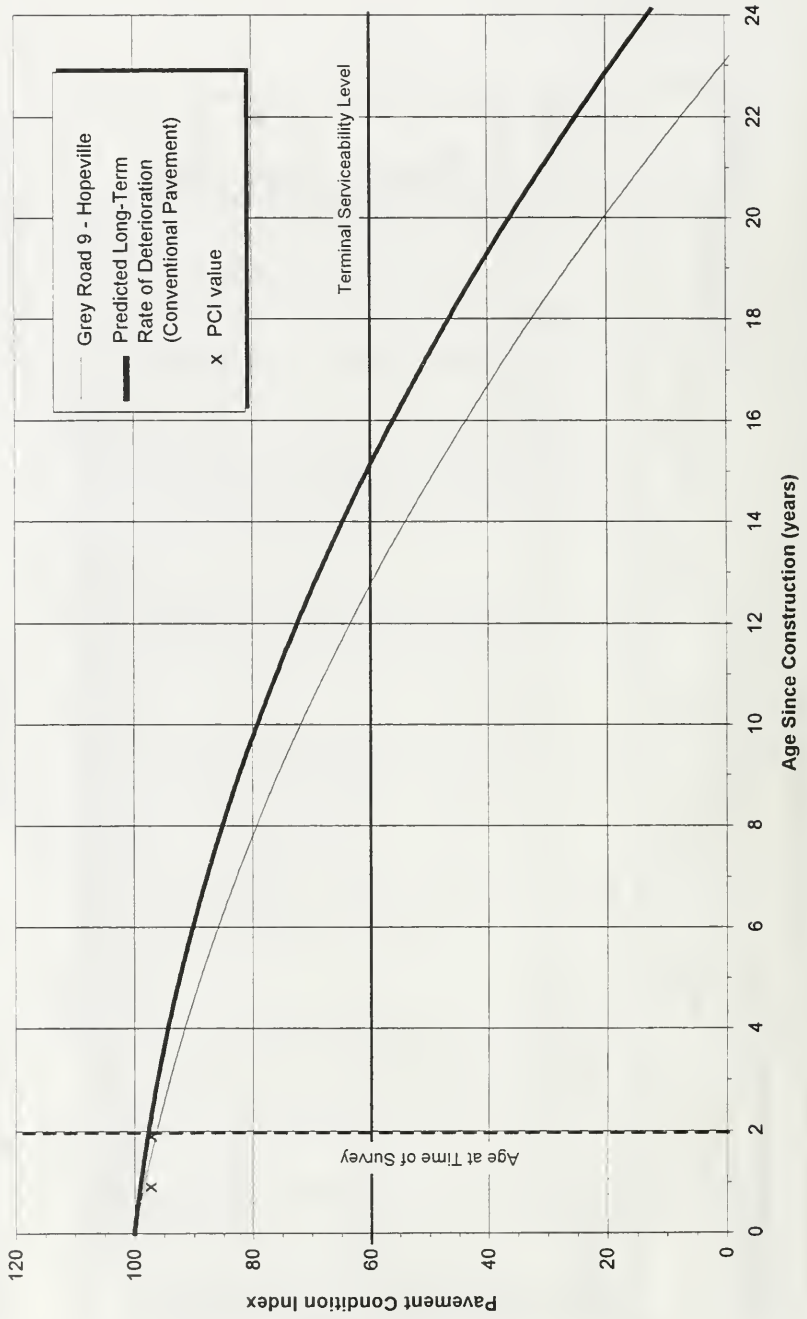
Detailed Pavement Distresses for 1996

Detailed Pavement Distresses for 1996										Remarks
Station	Pavement Distress Type									
	Cracks									
	Transverse (m)	Meandering (m)	Longitudinal (m)	Edge (m)	Alligator (m ²)	Construction Joint (m)	Ravelling (m ²)	Patching (m ²)		
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Low	
0+000 Start of Control Section										
0+900 Start of Wet Process Section										
1+190	7									
1+600										
2+906 to 3+326 - Honeville										
4+320	7									
4+410						15				
4+500						5				
4+780						10				
4+900						5				
5+281 Start of Wet/Dry Process Section										
5+600										
5+730						100				
5+995						5				
6+506 Start of Dry Process Section										
6+900	1									
6+900	1.5									
7+329										
Total, 1996										
	10	7	0	10	100	0	35	0	0	0

Detailed Pavement Distresses for 1997

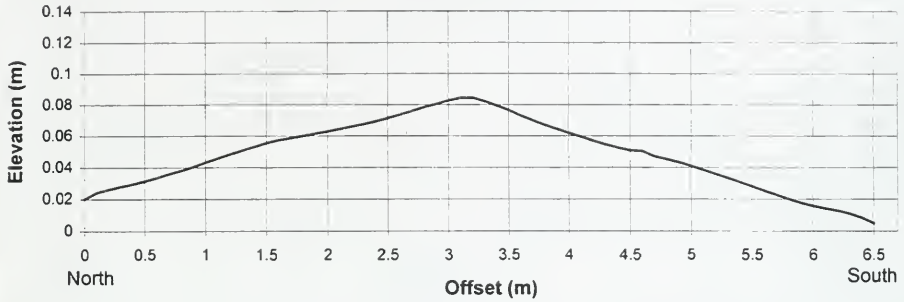
- A3 -

Pavement Life-Cycle Modelling A1. Grey Road 9 - Hopeville

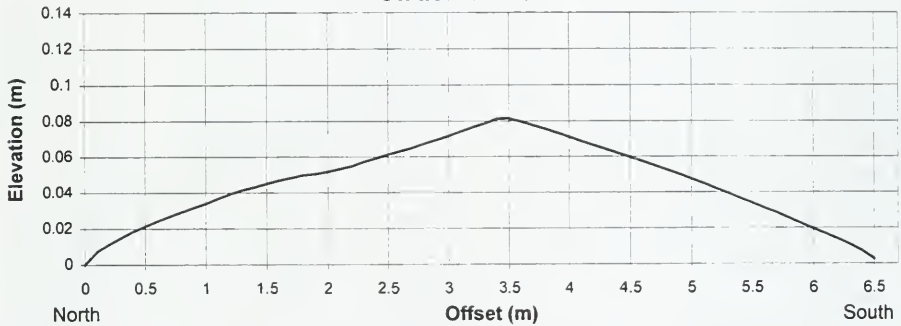


Pavement Profile Measurements

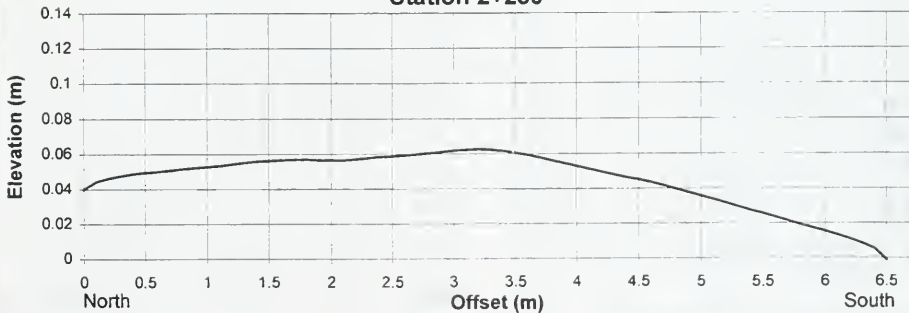
**A1. Grey County Road 9 - Hopeville
Station 0+010**



**A1. Grey County Road 9 - Hopeville
Station 1+250**

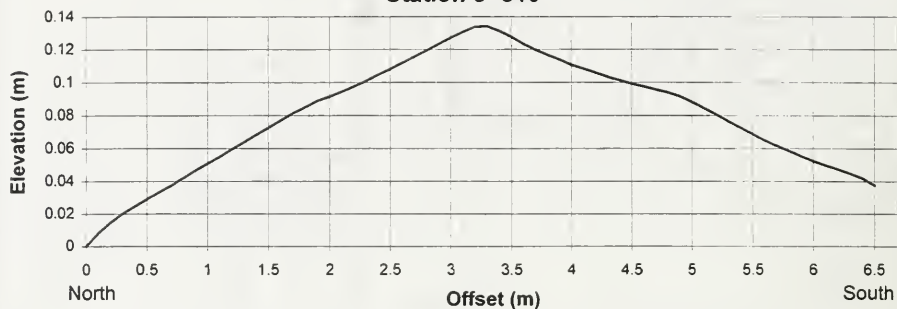


**A1. Grey County Road 9 - Hopeville
Station 2+280**



Pavement Profile Measurements

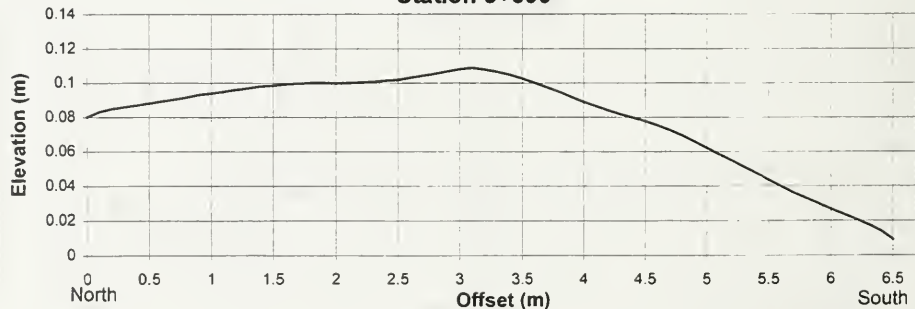
**A1. Grey County Road 9 - Hopeville
Station 3+510**



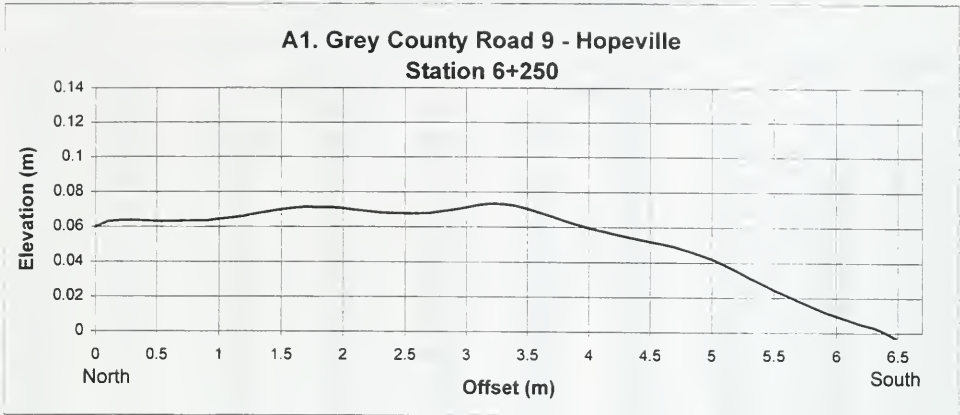
**A1. Grey County Road 9 - Hopeville
Station 4+700**



**A1. Grey County Road 9 - Hopeville
Station 5+390**



Pavement Profile Measurements



PAVEMENT DEFLECTION ANALYSIS RESULTS

A1, GREY COUNTY ROAD 9

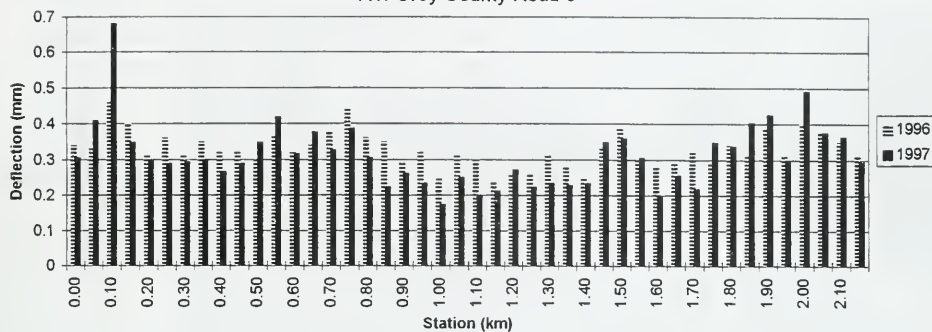
3 km East of Hopeville to 4 km West of Hopeville

Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
0.00	EBL	0.34	0.56	0.31	434	267	473
0.05	WBL	0.33	0.75	0.41	455	197	349
0.10	EBL	0.46	1.25	0.68	322	119	211
0.15	WBL	0.4	0.64	0.35	376	233	412
0.20	EBL	0.31	0.55	0.30	474	269	476
0.25	WBL	0.36	0.53	0.29	418	281	497
0.30	EBL	0.31	0.54	0.30	473	274	485
0.35	WBL	0.35	0.55	0.30	429	270	478
0.40	EBL	0.32	0.49	0.27	467	301	533
0.45	WBL	0.32	0.53	0.29	463	281	497
0.50	EBL	0.3	0.64	0.35	501	231	409
0.55	WBL	0.37	0.77	0.42	400	193	342
0.60	EBL	0.32	0.58	0.32	464	257	455
0.65	WBL	0.34	0.69	0.38	440	215	381
0.70	EBL	0.38	0.6	0.33	393	248	439
0.75	WBL	0.44	0.71	0.39	336	210	372
0.80	EBL	0.36	0.56	0.31	416	264	467
0.85	WBL	0.35	0.41	0.22	422	365	646
0.90	EBL	0.29	0.48	0.26	515	308	545
0.95	WBL	0.32	0.43	0.23	466	348	616
1.00	EBL	0.25	0.32	0.17	586	470	832
1.05	WBL	0.31	0.46	0.25	487	321	568
1.10	EBL	0.3	0.37	0.20	494	398	704
1.15	WBL	0.24	0.39	0.21	625	379	671
1.20	EBL	0.26	0.5	0.27	572	300	531
1.25	WBL	0.26	0.41	0.22	580	360	637
1.30	EBL	0.31	0.43	0.23	474	347	614
1.35	WBL	0.28	0.42	0.23	527	351	621
1.40	EBL	0.25	0.43	0.23	593	347	614
1.45	WBL	0.33	0.64	0.35	448	232	411
1.50	EBL	0.39	0.66	0.36	377	224	396
1.55	WBL	0.3	0.56	0.31	493	264	467
1.60	EBL	0.28	0.37	0.20	534	405	717
1.65	WBL	0.29	0.47	0.26	508	319	565
1.70	EBL	0.32	0.4	0.22	464	372	658
1.75	WBL	0.29	0.64	0.35	514	233	412
1.80	EBL	0.34	0.62	0.34	438	240	425
1.85	WBL	0.31	0.74	0.40	477	201	356
1.90	EBL	0.39	0.78	0.43	377	192	340
1.95	WBL	0.31	0.55	0.30	476	273	483
2.00	EBL	0.4	0.9	0.49	372	165	292
2.05	WBL	0.38	0.69	0.38	389	216	382
2.10	EBL	0.35	0.67	0.37	428	222	393
2.15	WBL	0.31	0.54	0.30	479	278	492
2.20	EBL	0.27	0.46	0.25	554	326	577
2.25	WBL	0.3	0.54	0.30	505	277	490

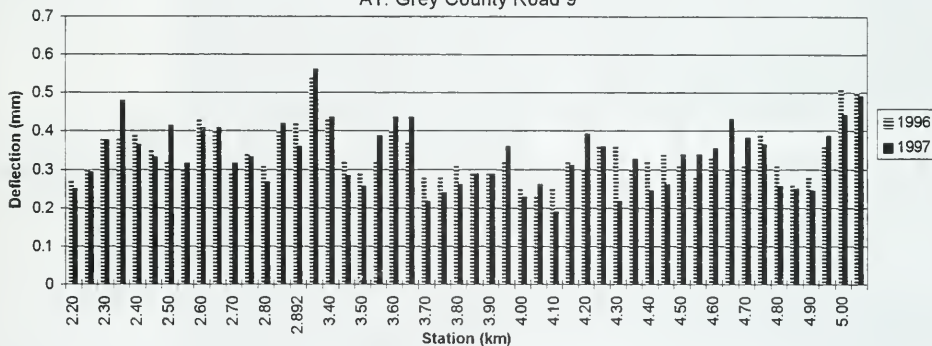
Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
2.30	EBL	0.38	0.69	0.38	394	217	384
2.35	WBL	0.38	0.88	0.48	392	170	301
2.40	EBL	0.39	0.67	0.37	386	222	393
2.45	WBL	0.35	0.61	0.33	431	243	430
2.50	EBL	0.32	0.76	0.42	463	196	347
2.55	WBL	0.3	0.58	0.32	503	256	453
2.60	EBL	0.43	0.75	0.41	345	199	352
2.65	WBL	0.4	0.75	0.41	374	200	354
2.70	EBL	0.29	0.58	0.32	508	257	455
2.75	WBL	0.34	0.61	0.33	438	244	432
2.80	EBL	0.31	0.49	0.27	477	304	538
2.85	WBL	0.4	0.77	0.42	372	194	343
2.892	EBL	0.42	0.66	0.36	357	225	398
3.35	WBL	0.54	1.03	0.56	276	145	257
3.40	EBL	0.43	0.8	0.44	343	186	329
3.45	WBL	0.32	0.52	0.28	466	284	503
3.50	EBL	0.29	0.47	0.26	512	318	563
3.55	WBL	0.32	0.71	0.39	467	211	373
3.60	EBL	0.4	0.8	0.44	371	186	329
3.65	WBL	0.37	0.8	0.44	402	186	329
3.70	EBL	0.28	0.4	0.22	526	373	660
3.75	WBL	0.28	0.44	0.24	534	336	595
3.80	EBL	0.31	0.48	0.26	487	312	552
3.85	WBL	0.29	0.53	0.29	520	283	501
3.90	EBL	0.29	0.53	0.29	511	279	494
3.95	WBL	0.32	0.66	0.36	462	224	396
4.00	EBL	0.25	0.42	0.23	604	358	634
4.05	WBL	0.23	0.48	0.26	639	313	554
4.10	EBL	0.25	0.35	0.19	589	426	754
4.15	WBL	0.32	0.57	0.31	472	259	458
4.20	EBL	0.3	0.72	0.39	492	207	366
4.25	WBL	0.36	0.66	0.36	413	226	400
4.30	EBL	0.36	0.4	0.22	416	377	667
4.35	WBL	0.3	0.6	0.33	491	249	441
4.40	EBL	0.32	0.45	0.25	473	329	582
4.45	WBL	0.34	0.48	0.26	436	308	545
4.50	EBL	0.31	0.62	0.34	487	241	427
4.55	WBL	0.28	0.62	0.34	539	239	423
4.60	EBL	0.33	0.65	0.36	452	228	404
4.65	WBL	0.3	0.79	0.43	502	188	333
4.70	EBL	0.31	0.7	0.38	487	212	375
4.75	WBL	0.39	0.67	0.37	384	221	391
4.80	EBL	0.31	0.47	0.26	485	320	566
4.85	WBL	0.26	0.46	0.25	564	327	579
4.90	EBL	0.28	0.45	0.25	530	329	582
4.95	WBL	0.36	0.71	0.39	417	211	373
5.00	EBL	0.51	0.81	0.44	291	184	326
5.05	WBL	0.5	0.9	0.49	297	166	294
5.10	EBL	0.36	0.54	0.30	409	278	492
5.15	WBL	0.31	0.59	0.32	485	252	446

Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
5.20	EBL	0.39	0.53	0.29	387	280	496
5.25	WBL	0.32	0.79	0.43	470	190	336
5.30	EBL	0.43	0.61	0.33	346	246	435
5.35	WBL	0.41	0.81	0.44	360	183	324
5.40	EBL	0.34	0.6	0.33	435	246	435
5.45	WBL	0.39	0.98	0.54	378	153	271
5.50	EBL	0.38	0.64	0.35	394	231	409
5.55	WBL	0.38	0.8	0.44	392	186	329
5.60	EBL	0.38	0.85	0.46	393	175	310
5.65	WBL	0.41	0.84	0.46	359	177	313
5.70	EBL	0.44	0.9	0.49	340	165	292
5.75	WBL	0.45	1.03	0.56	329	145	257
5.80	EBL	0.47	0.74	0.40	315	201	356
5.85	WBL	0.49	0.8	0.44	302	186	329
5.90	EBL	0.3	0.62	0.34	490	240	425
5.95	WBL	0.33	0.47	0.26	455	319	565
6.00	EBL	0.31	0.61	0.33	475	243	430
6.05	WBL	0.34	0.8	0.44	442	186	329
6.10	EBL	0.35	0.79	0.43	430	188	333
6.15	WBL	0.34	0.84	0.46	445	176	312
6.20	EBL	0.33	0.53	0.29	453	279	494
6.25	WBL	0.34	0.76	0.42	434	195	345
6.30	EBL	0.48	0.69	0.38	312	216	382
6.35	WBL	0.41	0.69	0.38	365	216	382
6.40	EBL	0.51	0.76	0.42	290	196	347
6.45	WBL	0.53	0.82	0.45	278	181	320
6.50	EBL	0.44	0.83	0.45	339	179	317
6.55	WBL	0.58	0.91	0.50	256	164	290
6.60	EBL	0.5	0.8	0.44	295	186	329
6.65	WBL	0.55	0.79	0.43	270	188	333
6.70	EBL	0.49	0.88	0.48	303	169	299
6.75	WBL	0.47	1.17	0.64	320	127	225
6.80	EBL	0.46	0.85	0.46	320	176	312
6.85	WBL	0.53	0.98	0.54	280	152	269
6.90	EBL	0.43	0.86	0.47	343	172	304
6.95	WBL	0.44	0.69	0.38	340	217	384
7.00	EBL	0.36	0.81	0.44	419	184	326
7.05	WBL	0.3	0.86	0.47	490	172	304
7.10	EBL	0.43	0.93	0.51	344	160	283
7.15	WBL	0.42	1.17	0.64	351	128	227
7.20	EBL	0.41	0.99	0.54	363	150	266
7.25	WBL	0.46	0.8	0.44	321	185	327
7.30	EBL	0.37	0.69	0.38	407	216	382
7.324	WBL	0.33			448		
Mean		0.36	0.66	0.36	431	244	431
Standard Deviation		0.07	0.18	0.10	82.0	69.0	122.1
Coefficient of Variation		20.4	27.5	27.5	19.0	28.3	28.3

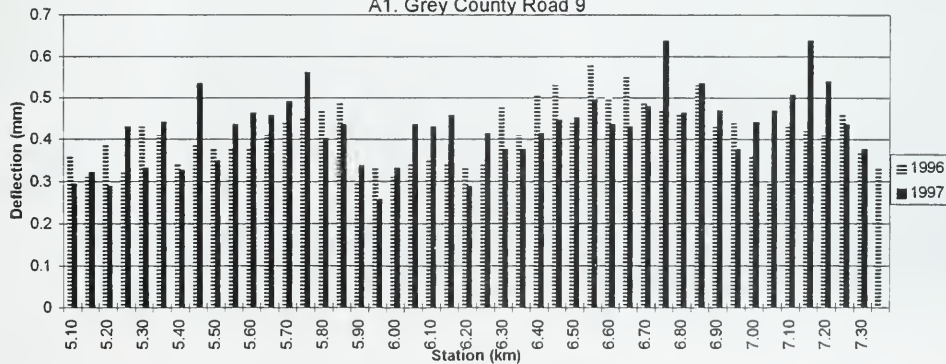
FWD Deflection
A1. Grey County Road 9



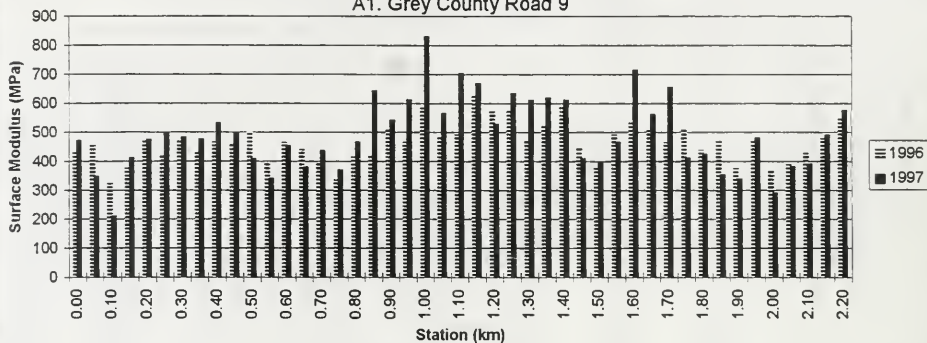
FWD Deflection
A1. Grey County Road 9



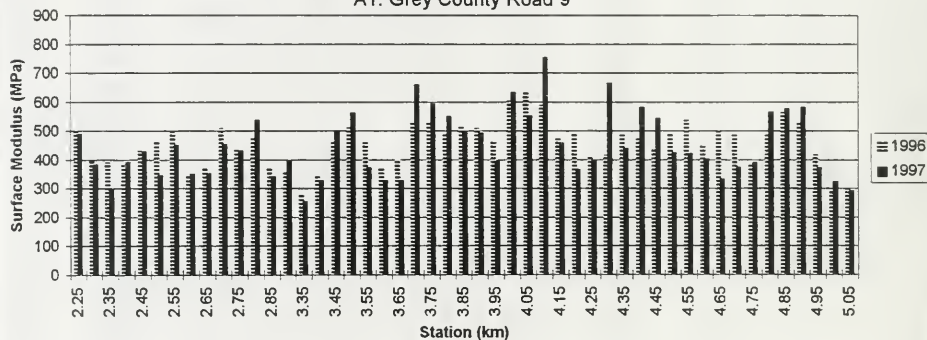
FWD Deflection
A1. Grey County Road 9



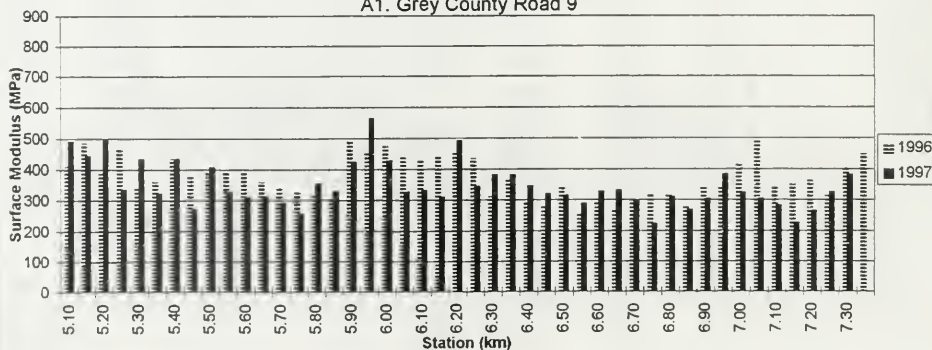
Surface Modulus
A1. Grey County Road 9



Surface Modulus
A1. Grey County Road 9



Surface Modulus
A1. Grey County Road 9





1996

Photograph A1-1a
Station 5+200,
looking west.
transition from wet
process (foreground)
to wet/dry process
(left background).
[06/27/96, MB]

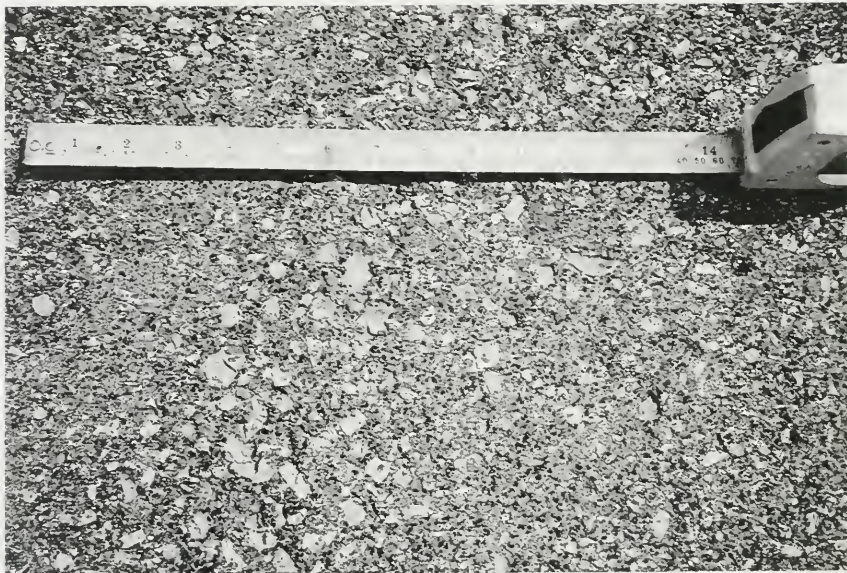


1997

Photograph A1-1b
Station 2+900,
looking east, wet
process.
[05/24/97, PP]

Photograph A1-1 Grey County Road 9 (1995 section) showing HL 4 (Wet Process) in 1996 (Photograph A1-1a) and 1997 (Photograph A1-1b). Note slight increase in frequency of surface pop-outs in 1997.

1996



Photograph A1-2 Grey County Road 9 (1995 section) at Station 6+460. Close up of RMA dry process. Note crumb rubber (black particles) and fractured natural aggregates. [06/27/96, MB]

1997



Photograph A1-3 Grey County Road 9 (1995 section) looking east at Station 4+410. Note high severity meandering crack in the eastbound lane associated with frost heave, which is the most significant distress feature present but is not related to RMA use. [05/26/97, PP]

A2. Grey County Road 9

Location: 3 km east of Hopeville to County Road 8, 7.1 km.

7+130	6+000	5+000	1+800	0+700	0+000	N ↑
HL 4	HL 4	HL 4	HL 4	HL 4		
Control	Dry	Wet Terminal	Wet Portable	Control		

County Road 8

Construction Date: October, 1994

Contractor: The Murray Group

Distress Summary:

Section / Distress Type	Year					
	1996			1997		
	Low	Moderate	High	Low	Moderate	High
Control Section 1						
Edge (m)	400			400		
Alligator (m ²)				5		
PCI		96			95	
Wet Portable Section						
Edge (m)	50			50		
Ravelling (m ²)	300			300		
PCI		96			96	
Wet Terminal Section						
Transverse (m)	14			14		
Meandering (m)	20			20		
Construction Joint (m)	720			720		
PCI		98			98	
Dry Section						
Construction Joint (m)	1000			1000		
Edge (m)	200			200		
PCI		87			87	
Control Section 2						
Construction Joint (m)	800			800		
Edge (m)				300		
PCI		92			88	
Overall PCI		93			92	

Comments: Crack sealing performed in 1996.

Rubber Modified Asphalt Detailed Pavement Monitoring Sections
 A2. Grey County Road 9 from County Road 8 to 3 km east of Hopeville

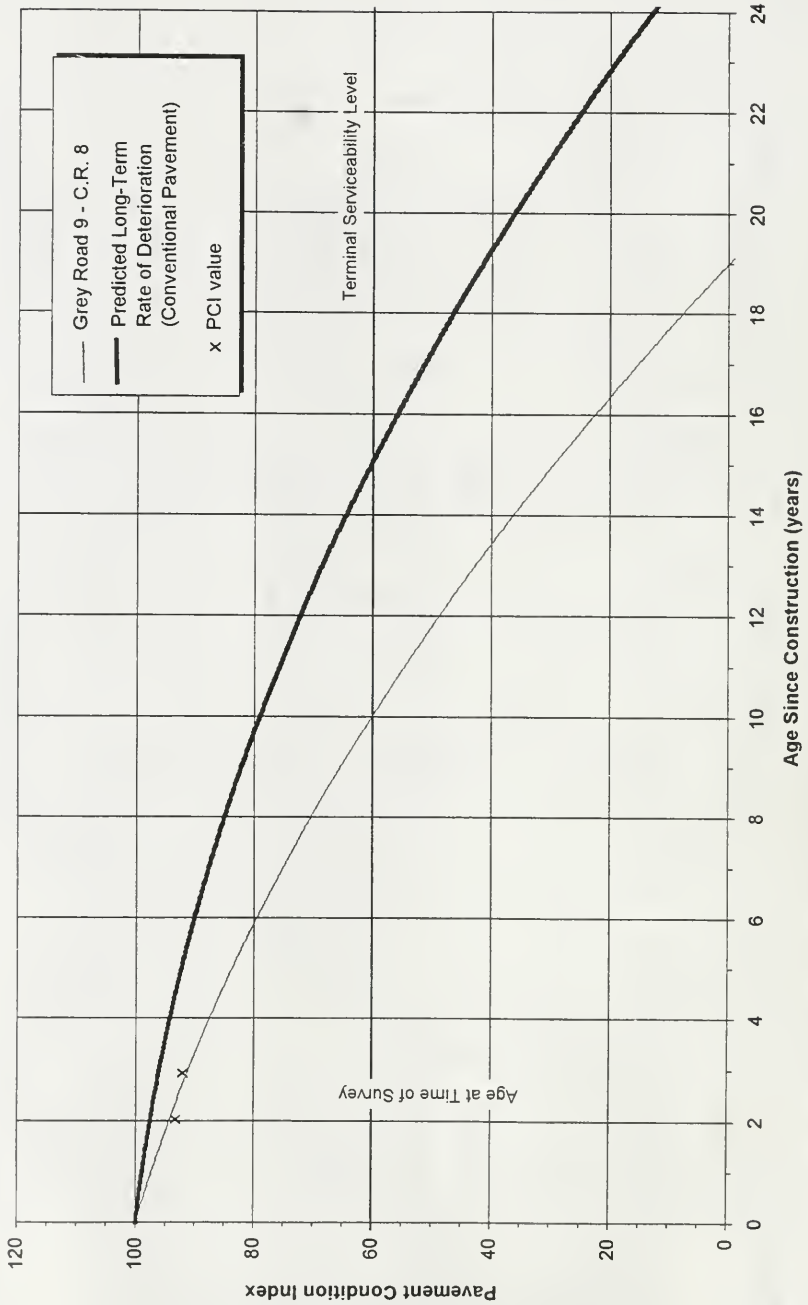
Detailed Pavement Distresses for 1996

Station	Pavement Distress Type														Remarks	
Cracks															Ravelling (m ²)	Patching (m ²)
Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)						
Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate				
0+000 Start of Control Section							400									slight agg loss throughout
0+700 Start of Wet Portable Section							50								300	
1+800 Start of Wet Terminal Section																
2+500				20												
4+100											720					
4+400	7															
4+405	7															
5+000 Start of Dry Section											1000					
5+600																
6+000 Start of second Control Section							200									
7+130											800					
Total, 1996	Transverse		Meandering		Longitudinal		Edge		Alligator		Construction Joint		Ravelling	Patching		End
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Low	
	14	0	0	20	0	0	650	0	0	0	2520	0	300	0	0	

Detailed Pavement Distresses for 1997

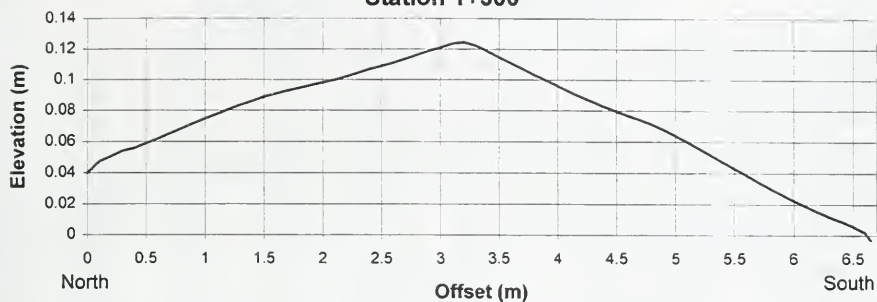
Station	Pavement Distress Type														Remarks	
	Cracks															
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)	Patching (m ²)		
0+000 Start of Control Section	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Low	slight agg loss throughout
								400								
0+300																slight agg loss throughout
0+700 Start of Wet Portable Section																
1+800 Start of Wet Terminal Section								50						300		
2+500							20									
4+100												720				
4+400																
4+405																
5+000 Start of Dry Section												1000				
5+600								200								
6+000 Start of second Control Section												800				
6+200								150								WBL EBL
6+200								150								
7+130																End
Total, 1997	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Ravelling	Patching	
	14	0	0	20	0	0	0	950	0	5	0	2520	0	300	0	

Pavement Life-Cycle Modelling
A2. Grey Road 9 - C.R. 8

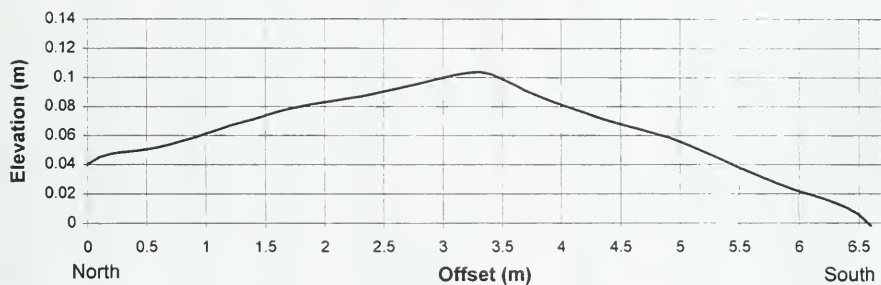


Pavement Profile Measurements

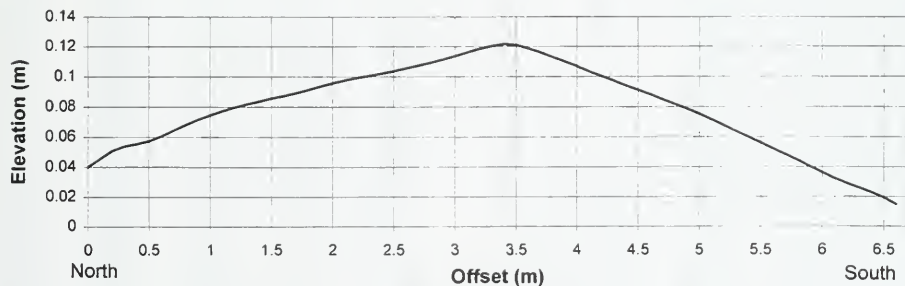
**A2. Grey County Road 9
Station 1+300**



**A2. Grey County Road 9
Station 2+520**

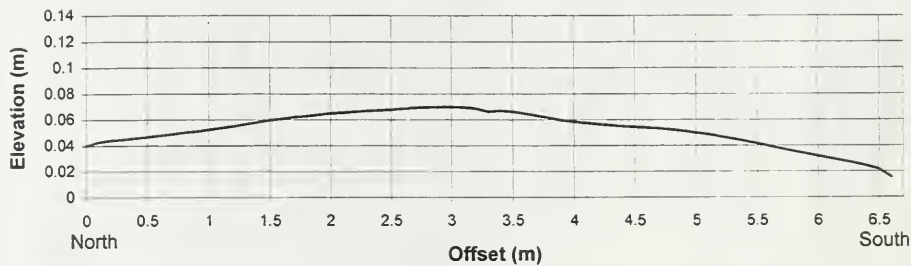


**A2. Grey County Road 9
Station 3+260**

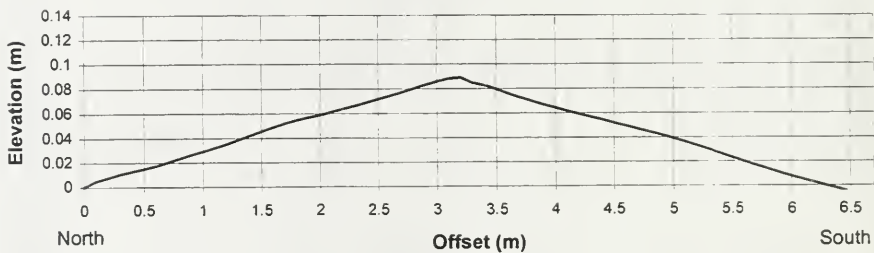


Pavement Profile Measurements

**A2. Grey County Road 9
Station 4+500**



**A2. Grey County Road 9
Station 6+000**



PAVEMENT DEFLECTION ANALYSIS RESULTS

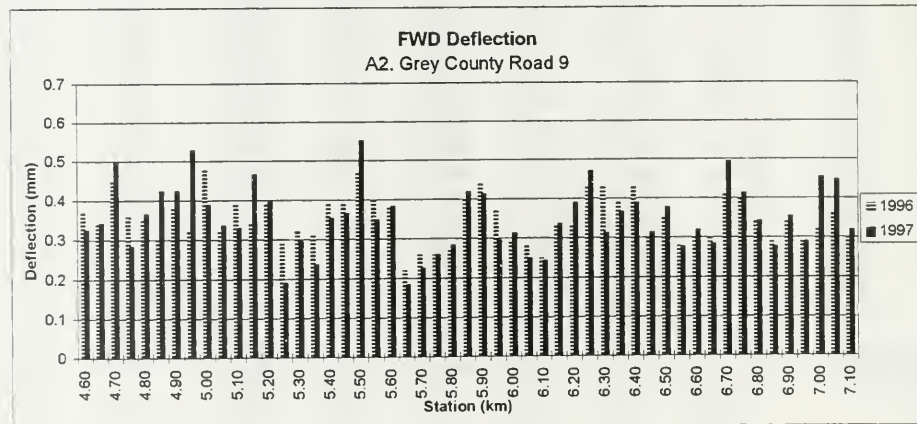
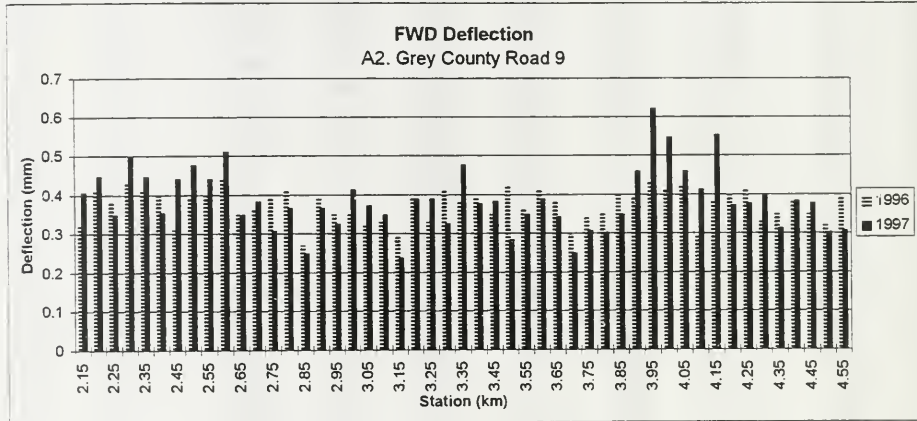
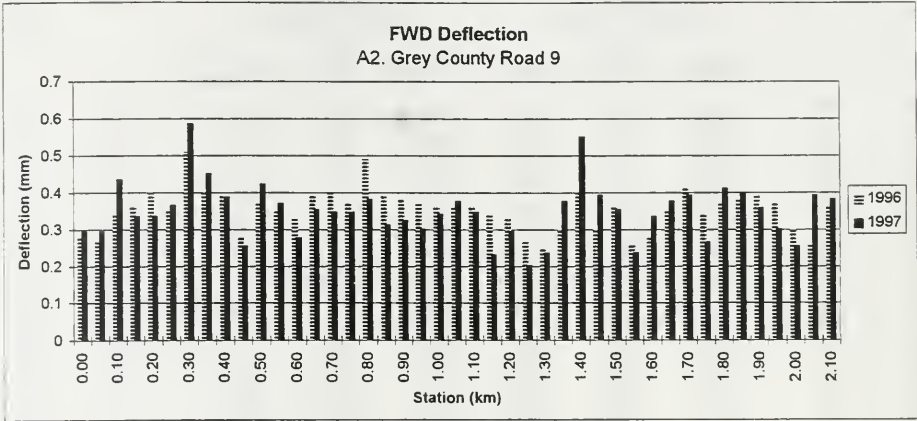
A2. GREY COUNTY ROAD 9

County Road 8 to 3 km East of Hopeville

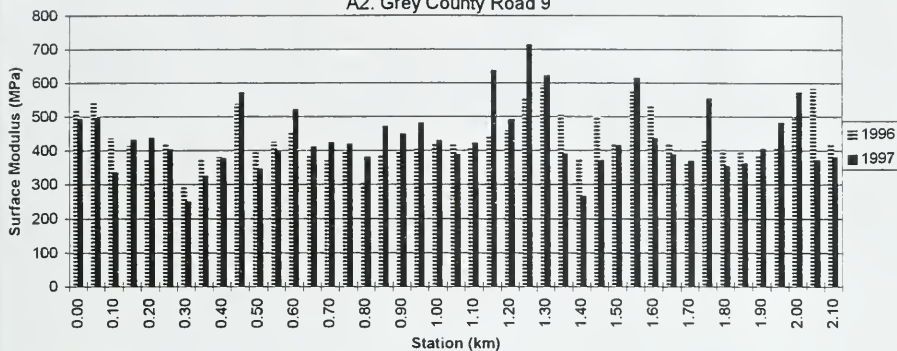
Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
0.00	WBL	0.28	0.51	0.30	524	291	493
0.05	EBL	0.27	0.51	0.30	542	293	497
0.10	WBL	0.34	0.75	0.44	435	198	336
0.15	EBL	0.36	0.58	0.34	414	255	432
0.20	WBL	0.4	0.58	0.34	376	258	437
0.25	EBL	0.35	0.63	0.37	420	238	403
0.30	WBL	0.51	1.01	0.59	293	148	251
0.35	EBL	0.4	0.78	0.45	377	192	325
0.40	WBL	0.39	0.67	0.39	379	222	376
0.45	EBL	0.28	0.44	0.26	536	337	571
0.50	WBL	0.37	0.73	0.42	397	204	346
0.55	EBL	0.35	0.64	0.37	423	235	398
0.60	WBL	0.33	0.48	0.28	455	308	522
0.65	EBL	0.39	0.61	0.35	382	242	410
0.70	WBL	0.4	0.6	0.35	369	250	424
0.75	EBL	0.37	0.6	0.35	398	247	419
0.80	WBL	0.49	0.66	0.38	303	225	381
0.85	EBL	0.39	0.54	0.31	383	278	471
0.90	WBL	0.38	0.56	0.33	396	265	449
0.95	EBL	0.37	0.52	0.30	402	284	481
1.00	WBL	0.36	0.59	0.34	418	253	429
1.05	EBL	0.36	0.65	0.38	416	229	388
1.10	WBL	0.36	0.6	0.35	410	249	422
1.15	EBL	0.34	0.4	0.23	442	376	637
1.20	WBL	0.33	0.51	0.30	457	290	492
1.25	EBL	0.27	0.35	0.20	557	421	714
1.30	WBL	0.25	0.41	0.24	593	367	622
1.35	EBL	0.3	0.65	0.38	503	230	390
1.40	WBL	0.4	0.95	0.55	377	157	266
1.45	EBL	0.3	0.68	0.40	500	219	371
1.50	WBL	0.36	0.61	0.35	417	245	415
1.55	EBL	0.26	0.41	0.24	573	363	615
1.60	WBL	0.28	0.58	0.34	531	257	436
1.65	EBL	0.35	0.65	0.38	420	229	388
1.70	WBL	0.41	0.68	0.40	364	218	369
1.75	EBL	0.34	0.46	0.27	432	327	554
1.80	WBL	0.37	0.71	0.41	401	209	354
1.85	EBL	0.38	0.69	0.40	394	214	363
1.90	WBL	0.39	0.62	0.36	384	239	405
1.95	EBL	0.37	0.52	0.30	405	285	483
2.00	WBL	0.3	0.44	0.26	496	338	573
2.05	EBL	0.26	0.68	0.40	583	220	373
2.10	WBL	0.36	0.66	0.38	419	225	381
2.15	EBL	0.32	0.7	0.41	470	212	359
2.20	WBL	0.41	0.77	0.45	367	194	329
2.25	EBL	0.38	0.6	0.35	387	250	424
2.30	WBL	0.43	0.86	0.50	346	174	295

Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
2.35	EBL	0.41	0.77	0.45	361	192	325
2.40	WBL	0.4	0.61	0.35	368	245	415
2.45	EBL	0.31	0.76	0.44	473	195	331
2.50	WBL	0.39	0.82	0.48	382	182	308
2.55	EBL	0.4	0.76	0.44	369	196	332
2.60	WBL	0.44	0.88	0.51	342	170	288
2.65	EBL	0.35	0.6	0.35	431	250	424
2.70	WBL	0.36	0.66	0.38	415	227	385
2.75	EBL	0.39	0.53	0.31	379	281	476
2.80	WBL	0.41	0.63	0.37	360	238	403
2.85	EBL	0.27	0.43	0.25	545	350	593
2.90	WBL	0.39	0.63	0.37	383	235	398
2.95	EBL	0.35	0.56	0.33	430	268	454
3.00	WBL	0.35	0.71	0.41	429	210	356
3.05	EBL	0.32	0.64	0.37	465	234	397
3.10	WBL	0.33	0.6	0.35	452	247	419
3.15	EBL	0.29	0.41	0.24	516	360	610
3.20	WBL	0.39	0.67	0.39	386	222	376
3.25	EBL	0.33	0.67	0.39	457	223	378
3.30	WBL	0.41	0.56	0.33	360	264	447
3.35	EBL	0.38	0.82	0.48	393	181	307
3.40	WBL	0.39	0.65	0.38	387	228	386
3.45	EBL	0.35	0.66	0.38	425	227	385
3.50	WBL	0.42	0.49	0.28	355	305	517
3.55	EBL	0.36	0.6	0.35	416	246	417
3.60	WBL	0.41	0.67	0.39	364	224	380
3.65	EBL	0.38	0.59	0.34	392	251	425
3.70	WBL	0.3	0.43	0.25	493	349	592
3.75	EBL	0.34	0.53	0.31	439	279	473
3.80	WBL	0.35	0.52	0.30	426	286	485
3.85	EBL	0.4	0.6	0.35	377	246	417
3.90	WBL	0.39	0.79	0.46	380	188	319
3.95	EBL	0.43	1.07	0.62	346	139	236
4.00	WBL	0.41	0.94	0.55	363	159	269
4.05	EBL	0.42	0.79	0.46	358	189	320
4.10	WBL	0.29	0.71	0.41	507	211	358
4.15	EBL	0.38	0.95	0.55	394	157	266
4.20	WBL	0.4	0.64	0.37	376	234	397
4.25	EBL	0.41	0.65	0.38	365	230	390
4.30	WBL	0.33	0.69	0.40	447	215	364
4.35	EBL	0.35	0.54	0.31	421	275	466
4.40	WBL	0.38	0.66	0.38	397	227	385
4.45	EBL	0.35	0.65	0.38	430	228	386
4.50	WBL	0.32	0.52	0.30	467	288	488
4.55	EBL	0.39	0.53	0.31	384	280	475
4.60	WBL	0.37	0.56	0.33	402	268	454
4.65	EBL	0.34	0.59	0.34	437	253	429
4.70	WBL	0.45	0.86	0.50	333	174	295
4.75	EBL	0.36	0.49	0.28	411	302	512
4.80	WBL	0.35	0.63	0.37	426	238	403
4.85	EBL	0.3	0.73	0.42	498	205	347

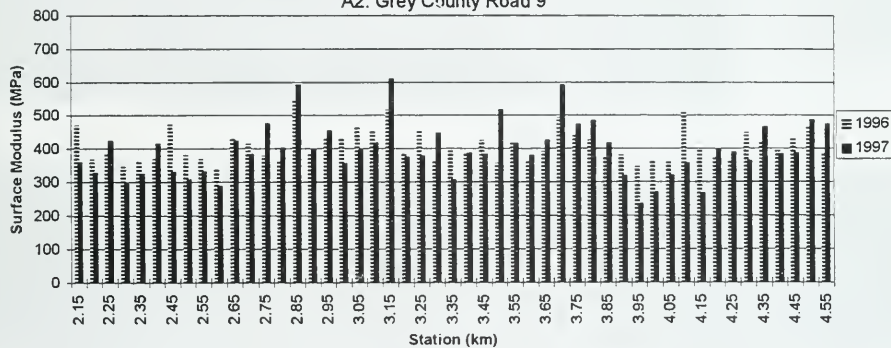
Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
4.90	WBL	0.38	0.73	0.42	389	204	346
4.95	EBL	0.32	0.91	0.53	466	165	280
5.00	WBL	0.48	0.67	0.39	310	223	378
5.05	EBL	0.32	0.58	0.34	469	256	434
5.10	WBL	0.39	0.57	0.33	384	260	441
5.15	EBL	0.34	0.8	0.47	437	187	317
5.20	WBL	0.39	0.68	0.40	385	220	373
5.25	EBL	0.29	0.33	0.19	519	449	761
5.30	WBL	0.32	0.51	0.30	470	290	492
5.35	EBL	0.31	0.41	0.24	477	364	617
5.40	WBL	0.39	0.61	0.35	384	245	415
5.45	EBL	0.39	0.63	0.37	379	235	398
5.50	WBL	0.47	0.95	0.55	317	157	266
5.55	EBL	0.4	0.6	0.35	373	248	420
5.60	WBL	0.38	0.66	0.38	391	226	383
5.65	EBL	0.22	0.32	0.19	664	461	781
5.70	WBL	0.26	0.39	0.23	582	382	647
5.75	EBL	0.26	0.45	0.26	574	329	558
5.80	WBL	0.27	0.49	0.28	551	302	512
5.85	EBL	0.4	0.72	0.42	369	208	353
5.90	WBL	0.44	0.71	0.41	338	209	354
5.95	EBL	0.37	0.51	0.30	399	291	493
6.00	WBL	0.29	0.54	0.31	506	276	468
6.05	EBL	0.28	0.43	0.25	527	346	586
6.10	WBL	0.25	0.42	0.24	604	357	605
6.15	EBL	0.33	0.58	0.34	446	257	436
6.20	WBL	0.33	0.67	0.39	448	221	375
6.25	EBL	0.43	0.81	0.47	350	184	312
6.30	WBL	0.43	0.54	0.31	349	276	468
6.35	EBL	0.39	0.63	0.37	377	235	398
6.40	WBL	0.43	0.67	0.39	347	222	376
6.45	EBL	0.3	0.54	0.31	505	277	469
6.50	WBL	0.35	0.65	0.38	423	230	390
6.55	EBL	0.28	0.48	0.28	532	313	531
6.60	WBL	0.3	0.55	0.32	498	268	454
6.65	EBL	0.3	0.49	0.28	499	302	512
6.70	WBL	0.41	0.85	0.49	360	176	298
6.75	EBL	0.4	0.71	0.41	370	211	358
6.80	WBL	0.34	0.59	0.34	441	252	427
6.85	EBL	0.29	0.48	0.28	518	312	529
6.90	WBL	0.34	0.61	0.35	433	242	410
6.95	EBL	0.29	0.5	0.29	518	297	503
7.00	WBL	0.32	0.78	0.45	468	191	324
7.05	EBL	0.36	0.77	0.45	416	194	329
7.10	WBL	0.3	0.55	0.32	490	270	458
Mean		0.36	0.62	0.36	428	251	425
Standard Deviation		0.05	0.14	0.08	69.0	58.6	99.4
Coefficient of Variation		15.1	22.3	22.3	16.1	23.4	23.4



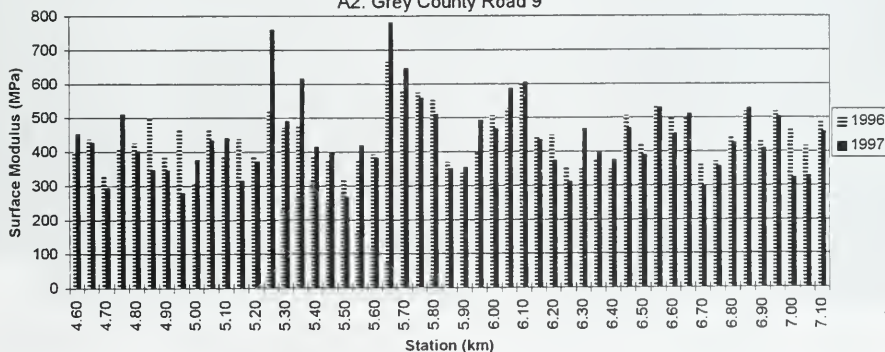
Surface Modulus
A2. Grey County Road 9



Surface Modulus
A2. Grey County Road 9



Surface Modulus
A2. Grey County Road 9



1996

Photograph A2-1a
Station 0-700, crack
sealing performed in
1996.

[06/27/96, MB]



1997

Photograph A2-1b
Station 3-260, slight
cracking in
wheelpaths.

[05/24/97, PP]



Photograph A2-1 Grey County Road 9 (1994 section) showing HL 4 (Wet Process - On-site Blend) in 1996 (Photograph A2-1a) and HL 4 (Wet Process) in 1997 (Photograph A2-1b). Note some cracking beyond extent of the crack sealing performed in 1996.

1996



Photograph A2-2 Grey County Road 9 (1994 section) at Station 0+000. Transition from existing pavement to conventional asphalt control section. [06/27/96, MB]

1997



Photograph A2-3 Grey County Road 9 (1994 section) at Station 5+700. Close-up showing coarse aggregate loss that is related to natural aggregate, not RMA use. [05/24/97, PP]

A3. Grey County Road 4

Location: Desboro to Highway 6, 11.2 km.

Distress Summary:

Distress Type	Year					
	1996			1997		
	Low	Moderate	High	Low	Moderate	High
Longitudinal (m)	356	18	0	356	18	0
Transverse (m)	88	81	28	88	81	28
Construction Joint (m)	10768	30	0	10768	30	0
Meandering (m)	30	0	0	30	0	0
Alligator (m ²)	0	0	0	0	0	0
Edge (m)	1212	15	0	1212	15	0
Ravelling (m ²)	91	0	0	91	0	0
Patching (m ²)	1163	0	0	1163	0	0
Potholes	7	0	0	7	0	0
PCI	84			84		

Comments: Some patching done with RMA, some with conventional asphalt; in fair condition with sporadic distresses.

Detailed Pavement Distresses for 1996 and 1997 (Note that there were no new distresses evident in 1997)

Station	Pavement Distress Type													Remarks		
	Cracks															
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)			
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate		Low	High
0+000																
0+100															5	
0+130															10	
0+170																
0+240																
0+275	7															
0+390																
0+410																
0+415																
0+450	7			3												
0+480																
0+550																
0+650																
0+680																
0+770																
0+860																
0+930			7													
1+030	3.5															
1+140																
1+150															1	
1+160																
1+210	7															
1+230																
1+290																
1+350															3	
1+360																
1+380																
1+400																
1+470															4	
1+500																
1+600	7														3	EBL
1+700																
1+730														30		EBL
1+740														500		

Detailed Pavement Distresses for 1996 and 1997 (Note that there were no new distresses evident in 1997)

Detailed Pavement Distresses for 1950 and 1957															Remarks		
Station	Pavement Distress Type														Remarks		
	Cracks																
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)	Patching (m ²)			
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low				Moderate	Low
1+780						15											
1+840	7																
1+860	3																
1+940				7													
1+970	7																
1+980				8											4		
2+030						6											
2+110	3.5																
2+220	3.5																
2+230		7						20									
2+290								10									
2+430																	
2+600												170					
2+630												30					
2+750												90					
2+810		7										1690					
2+990								8								45.5	WBL
3+060																	WBL
3+090										5							WBL
3+100																	WBL
3+120																	WBL
3+130				12												24.5	WBL
3+200																94.5	WBL
3+300						20											WBL
3+320																24.5	WBL
3+350																24.5	WBL
3+400																	
3+590	7																
3+620																	
3+720								60									
3+810			7														
3+880		7															
4+190		7															
4+305			7														
4+310		7															

(Note that there were no new distresses evident in 1997)

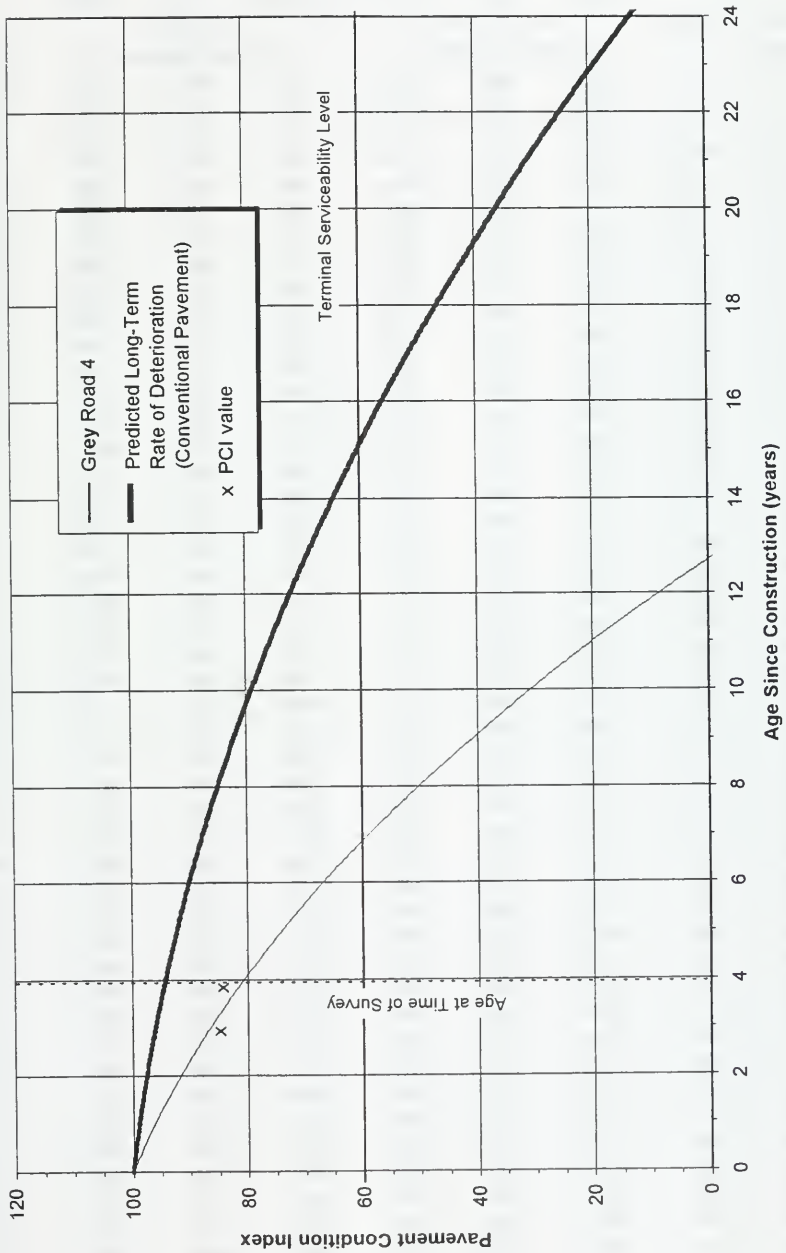
Station	Pavement Distress Type														Remarks
	Cracks														
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)	Patching (m ²)	
Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Low	
4+350															
4+510	7													2	
4+520											6660				
4+600							20								
4+720					5										
4+770							20								
4+810							145								
4+160							70								
5+520	7														
5+525	7														
5+610	4														
5+780															
5+880	7													5	
5+910	7														
5+920							90								
5+950						70									
6+320						35									
6+410															
6+500							90								
6+530							30								52.5 WBL
6+710							70								
6+760						30									
7+130															
7+300							50								
7+350							75								
7+430											4				
7+450							40								
7+730															
7+750							75				4				
8+150														1	
8+180															
8+200														1	
8+220						4									
8+260															
8+400						6								8	
															3 Potholes

A3. Grey County Road 4 from Hwy 6 to Desboro

Detailed Pavement Distresses for 1996 and 1997 (Note that there were no new distresses evident in 1997)

Station	Pavement Distress Type												Remarks		
	Cracks														
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)			Ravelling (m ²)	Patching (m ²)
Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Low	
8+420															NBL
8+425						10									
8+450															NBL
8+720															NBL
8+850							10								
8+850															
9+000						2									
9+010															
9+090															
9+200	7														
9+200															
9+250															
9+255						4									
9+480	3.5														SBL
9+510	2					10									
9+550															SBL
9+580						40									SBL
9+580															
9+630															
9+795															
9+840	7					10									
9+840															
9+930															
9+930													4	1	NBL
9+950						10									
10+190	4														
10+220						20									
10+370						20									
10+590	4														
10+590															
10+620	4														
10+700															
10+700															
10+730													10		NBL
10+810															
10+810															
10+890															Pothole
10+890														15	
11+180															End
	Transverse		Meandering		Longitudinal		Edge		Alligator		Construction Joint		Ravelling	Patching	
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Patching
Total, 1996/7	88	81	28	30	0	356	18	1212	15	0	0	10768	0	91	1163
															7 Potholes

Pavement Life-Cycle Modelling
A3. Grey Road 4



PAVEMENT DEFLECTION ANALYSIS RESULTS

A3. GREY COUNTY ROAD 4

Hwy 6 to Desboro

Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
0.00	WBL	0.20	0.42	0.19	751	351	747
0.05	EBL	0.19	0.39	0.18	791	377	802
0.10	WBL	0.18	0.36	0.17	838	419	891
0.15	EBL	0.23	0.46	0.21	639	324	689
0.20	WBL	0.20	0.46	0.21	745	322	685
0.25	EBL	0.25	0.58	0.27	606	259	551
0.30	WBL	0.26	0.56	0.26	567	266	566
0.35	EBL	0.25	0.51	0.23	603	291	619
0.40	WBL	0.24	0.45	0.21	613	331	704
0.45	EBL	0.35	0.67	0.31	429	222	472
0.50	WBL	0.26	0.55	0.25	571	273	581
0.55	EBL	0.29	0.58	0.27	516	256	545
0.60	WBL	0.25	0.51	0.23	599	290	617
0.65	EBL	0.33	0.64	0.29	458	234	498
0.70	WBL	0.28	0.58	0.27	527	258	549
0.75	EBL	0.27	0.61	0.28	550	245	521
0.80	WBL	0.28	0.58	0.27	534	255	543
0.85	EBL	0.23	0.48	0.22	634	310	660
0.90	WBL	0.35	0.99	0.46	424	150	319
0.95	EBL	0.27	0.46	0.21	553	325	691
1.00	WBL	0.31	0.53	0.24	484	283	602
1.05	EBL	0.26	0.58	0.27	563	258	549
1.10	WBL	0.27	0.48	0.22	555	310	660
1.15	EBL	0.35	1.02	0.47	420	146	311
1.20	WBL	0.18	0.41	0.19	820	367	781
1.25	EBL	0.39	1.17	0.54	378	127	270
1.30	WBL	0.30	0.75	0.35	493	198	421
1.35	EBL	0.39	1.21	0.56	384	123	262
1.40	WBL	0.36	1.23	0.57	413	121	257
1.45	EBL	0.35	1.00	0.46	422	149	317
1.50	WBL	0.32	0.87	0.40	471	172	366
1.55	EBL	0.34	0.88	0.40	432	170	362
1.60	WBL	0.38	0.72	0.33	396	207	440
1.65	EBL	0.40	0.85	0.39	372	174	370
1.70	WBL	0.33	0.83	0.38	452	180	383
1.75	EBL	0.33	0.83	0.38	458	181	385
1.80	WBL	0.29	0.57	0.26	510	261	555
1.85	EBL	0.30	0.65	0.30	492	228	485
1.90	WBL	0.21	0.32	0.15	698	470	1000
1.95	EBL	0.23	0.40	0.18	650	375	798
2.00	WBL	0.35	0.47	0.22	426	318	677
2.05	EBL	0.43	1.20	0.55	347	124	264
2.10	WBL	0.30	0.52	0.24	492	286	609

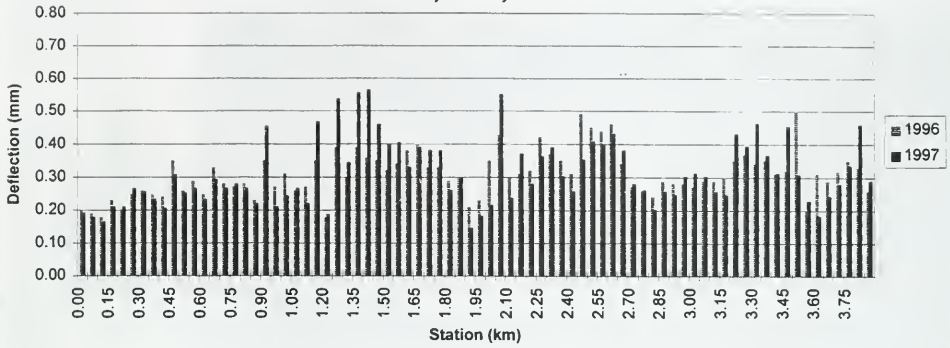
Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
2.15	EBL	0.31	0.81	0.37	474	185	394
2.20	WBL	0.32	0.61	0.28	470	244	519
2.25	EBL	0.42	0.79	0.36	352	188	400
2.30	WBL	0.37	0.85	0.39	402	176	374
2.35	EBL	0.35	0.66	0.30	421	224	477
2.40	WBL	0.31	0.56	0.26	478	264	562
2.45	EBL	0.49	0.77	0.35	305	193	411
2.50	WBL	0.45	0.89	0.41	333	168	357
2.55	EBL	0.44	0.87	0.40	342	171	364
2.60	WBL	0.46	0.94	0.43	320	158	336
2.65	EBL	0.34	0.83	0.38	437	179	381
2.70	WBL	0.27	0.61	0.28	560	244	519
2.75	EBL	0.26	0.57	0.26	564	260	553
2.80	WBL	0.24	0.44	0.20	633	337	717
2.85	EBL	0.29	0.56	0.26	512	267	568
2.90	WBL	0.28	0.54	0.25	536	278	591
2.95	EBL	0.28	0.66	0.30	523	227	483
3.00	WBL	0.27	0.68	0.31	555	221	470
3.05	EBL	0.29	0.66	0.30	513	227	483
3.10	WBL	0.29	0.56	0.26	518	268	570
3.15	EBL	0.30	0.54	0.25	494	274	583
3.20	WBL	0.35	0.94	0.43	426	159	338
3.25	EBL	0.37	0.86	0.40	399	173	368
3.30	WBL	0.34	1.01	0.46	441	148	315
3.35	EBL	0.35	0.80	0.37	427	187	398
3.40	WBL	0.31	0.68	0.31	480	219	466
3.45	EBL	0.32	0.99	0.46	467	151	321
3.50	WBL	0.50	0.67	0.31	297	223	474
3.55	EBL	0.20	0.50	0.23	749	298	634
3.60	WBL	0.31	0.40	0.18	475	370	787
3.65	EBL	0.29	0.53	0.24	507	280	596
3.70	WBL	0.32	0.61	0.28	466	245	521
3.75	EBL	0.35	0.73	0.34	429	205	436
3.80	WBL	0.33	1.00	0.46	456	149	317
3.85	EBL	0.26	0.63	0.29	565	237	504
3.90	WBL	0.25	0.59	0.27	601	255	543
3.95	EBL	0.28	0.75	0.35	529	199	423
4.00	WBL	0.29	0.69	0.32	520	217	462
4.05	EBL	0.28	0.75	0.35	534	199	423
4.10	WBL	0.24	0.58	0.27	616	257	547
4.15	EBL	0.31	0.71	0.33	479	209	445
4.20	WBL	0.28	0.55	0.25	538	271	577
4.25	EBL	0.59	1.15	0.53	253	130	277
4.30	WBL	0.19	0.49	0.23	778	304	647
4.35	EBL	0.24	0.37	0.17	616	403	857
4.40	WBL	0.27	0.72	0.33	547	208	443
4.45	EBL	0.29	0.64	0.29	510	232	494

Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
4.50	WBL	0.33	1.09	0.50	457	137	291
4.55	EBL	0.39	1.12	0.52	381	133	283
4.60	WBL	0.40	0.84	0.39	373	177	377
4.65	EBL	0.34	0.82	0.38	436	182	387
4.70	WBL	0.25	0.63	0.29	587	238	506
4.75	EBL	0.25	0.64	0.29	592	231	491
4.80	WBL	0.30	0.80	0.37	492	185	394
4.85	EBL	0.22	0.57	0.26	669	260	553
4.90	WBL	0.20	0.44	0.20	754	336	715
4.95	EBL	0.19	0.45	0.21	773	330	702
5.00	WBL	0.17	0.31	0.14	871	478	1017
5.05	EBL	0.24	0.35	0.16	627	425	904
5.10	WBL	0.23	0.58	0.27	636	255	543
5.15	EBL	0.29	0.60	0.28	505	249	530
5.20	WBL	0.27	0.55	0.25	558	272	579
5.25	EBL	0.44	0.86	0.40	335	174	370
5.30	WBL	0.29	0.49	0.23	518	303	645
5.35	EBL	0.27	0.56	0.26	545	264	562
5.40	WBL	0.31	0.60	0.28	481	247	526
5.45	EBL	0.41	0.72	0.33	368	206	438
5.50	WBL	0.40	0.81	0.37	368	184	391
5.55	EBL	0.48	0.97	0.45	307	153	326
5.60	WBL	0.42	0.90	0.41	351	165	351
5.65	EBL	0.49	1.18	0.54	303	127	270
5.70	WBL	0.53	0.93	0.43	283	160	340
5.75	EBL	0.39	0.93	0.43	378	161	343
5.80	WBL	0.38	0.63	0.29	394	237	504
5.85	EBL	0.41	0.61	0.28	364	243	517
5.90	WBL	0.56	0.93	0.43	268	159	338
5.95	EBL	0.57	1.20	0.55	262	124	264
6.00	WBL	0.37	1.11	0.51	402	134	285
6.05	EBL	0.34	0.70	0.32	438	212	451
6.10	WBL	0.41	0.93	0.43	361	159	338
6.15	EBL	0.43	0.86	0.40	345	174	370
6.20	WBL	0.34	0.91	0.42	436	163	347
6.25	EBL	0.35	0.60	0.28	426	249	530
6.30	WBL	0.36	0.65	0.30	414	231	491
6.35	EBL	0.49	0.91	0.42	301	163	347
6.40	WBL	0.43	1.08	0.50	346	138	294
6.45	EBL	0.41	0.82	0.38	363	182	387
6.50	WBL	0.39	0.65	0.30	383	230	489
6.55	EBL	0.56	1.17	0.54	266	127	270
6.60	WBL	0.37	0.84	0.39	405	176	374
6.65	EBL	0.30	0.70	0.32	495	214	455
6.70	WBL	0.33	0.83	0.38	458	180	383
6.75	EBL	0.38	0.88	0.40	392	170	362
6.80	WBL	0.32	0.98	0.45	464	152	323

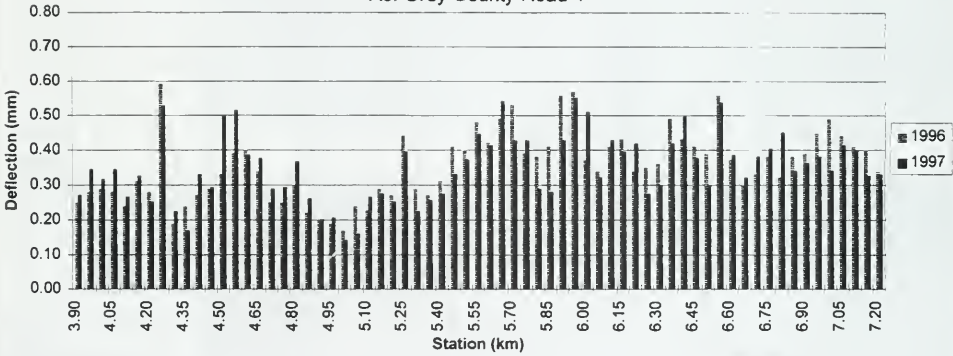
Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
6.85	EBL	0.38	0.74	0.34	394	201	428
6.90	WBL	0.39	0.79	0.36	383	189	402
6.95	EBL	0.45	0.83	0.38	331	180	383
7.00	WBL	0.49	0.74	0.34	305	200	426
7.05	EBL	0.44	0.90	0.41	337	165	351
7.10	WBL	0.41	0.87	0.40	364	171	364
7.15	EBL	0.40	0.71	0.33	376	209	445
7.20	WBL	0.34	0.72	0.33	439	206	438
7.25	EBL	0.47	0.95	0.44	317	157	334
7.30	WBL	0.30	0.65	0.30	499	229	487
7.35	EBL	0.37	0.74	0.34	398	201	428
7.40	WBL	0.32	0.74	0.34	463	201	428
7.45	EBL	0.38	0.64	0.29	397	231	491
7.50	WBL	0.36	0.90	0.41	414	165	351
7.55	EBL	0.38	0.78	0.36	387	190	404
7.60	WBL	0.37	0.98	0.45	402	151	321
7.65	EBL	0.33	0.80	0.37	445	187	398
7.70	WBL	0.40	1.02	0.47	375	146	311
7.75	EBL	0.27	0.51	0.23	557	292	621
7.80	WBL	0.17	0.60	0.28	899	250	532
7.85	EBL	0.18	0.34	0.16	818	438	932
7.90	WBL	0.30	0.83	0.38	498	180	383
7.95	EBL	0.28	0.71	0.33	528	209	445
8.00	WBL	0.29	0.68	0.31	511	218	464
8.05	EBL	0.34	0.74	0.34	434	202	430
8.10	WBL	0.26	0.72	0.33	563	205	436
8.15	EBL	0.34	0.56	0.26	434	266	566
8.20	WBL	0.27	0.79	0.36	543	188	400
8.25	EBL	0.28	0.67	0.31	530	223	474
8.30	WBL	0.41	0.89	0.41	366	167	355
8.35	EBL	0.38	0.73	0.34	394	203	432
8.40	WBL	0.22	0.77	0.35	683	195	415
8.45	EBL	0.20	0.47	0.22	733	319	679
8.50	WBL	0.22	0.41	0.19	675	366	779
8.55	EBL	0.22	0.39	0.18	677	384	817
8.60	WBL	0.33	0.47	0.22	449	317	674
8.65	EBL	0.35	0.74	0.34	426	202	430
8.70	WBL	0.46	0.62	0.29	326	240	511
8.75	EBL	0.33	0.90	0.41	449	165	351
8.80	WBL	0.28	0.62	0.29	529	241	513
8.85	EBL	0.25	0.57	0.26	593	263	560
8.90	WBL	0.23	0.43	0.20	659	346	736
8.95	EBL	0.30	0.47	0.22	504	320	681
9.00	WBL	0.27	0.60	0.28	552	248	528
9.05	EBL	0.50	0.87	0.40	299	172	366
9.10	WBL	0.43	1.05	0.48	348	142	302
9.15	EBL	0.62	0.89	0.41	239	168	357

Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
9.20	WBL	0.54	0.92	0.42	275	162	345
9.25	EBL	0.51	1.07	0.49	291	139	296
9.30	WBL	0.59	0.92	0.42	252	162	345
9.35	EBL	0.53	0.98	0.45	283	152	323
9.40	WBL	0.47	0.94	0.43	315	159	338
9.45	EBL	0.52	0.80	0.37	286	187	398
9.50	WBL	0.45	1.15	0.53	333	130	277
9.55	EBL	0.58	0.89	0.41	256	168	357
9.60	WBL	0.46	0.86	0.40	323	174	370
9.65	EBL	0.58	0.94	0.43	256	159	338
9.70	WBL	0.45	0.81	0.37	334	184	391
9.75	EBL	0.55	0.68	0.31	270	220	468
9.80	WBL	0.29	0.83	0.38	516	179	381
9.85	EBL	0.32	0.72	0.33	467	206	438
9.90	WBL	0.28	0.59	0.27	540	253	538
9.95	EBL	0.40	0.81	0.37	375	185	394
10.00	WBL	0.39	0.84	0.39	380	177	377
10.05	EBL	0.40	0.88	0.40	374	170	362
10.10	WBL	0.39	0.95	0.44	381	157	334
10.15	EBL	0.48	1.21	0.56	308	123	262
10.20	WBL	0.50	1.09	0.50	301	137	291
10.25	EBL	0.50	1.70	0.78	296	88	187
10.30	WBL	0.53	1.37	0.63	280	109	232
10.35	EBL	0.37	1.41	0.65	398	105	223
10.40	WBL	0.27	0.73	0.34	558	203	432
10.45	EBL	0.28	0.60	0.28	536	250	532
10.50	WBL	0.31	0.74	0.34	486	201	428
10.55	EBL	0.34	0.76	0.35	444	195	415
10.60	WBL	0.32	0.66	0.30	467	227	483
10.65	EBL	0.34	0.77	0.35	435	193	411
10.70	WBL	0.26	0.78	0.36	564	190	404
10.75	EBL	0.30	0.58	0.27	502	259	551
10.80	WBL	0.30	0.71	0.33	500	211	449
10.85	EBL	0.22	0.62	0.29	672	240	511
10.90	WBL	0.25	0.68	0.31	584	219	466
10.95	EBL	0.28	0.55	0.25	536	270	574
11.00	WBL	0.31	0.59	0.27	478	253	538
11.05	EBL	0.28	0.72	0.33	526	208	443
11.10	WBL	0.40	0.68	0.31	374	220	468
Mean		0.34	0.74	0.34	470	221	470
Standard Deviation		0.10	0.22	0.10	131	70.2	149
Coefficient of Variation		28.0	30.1	30.1	28.0	31.8	31.8

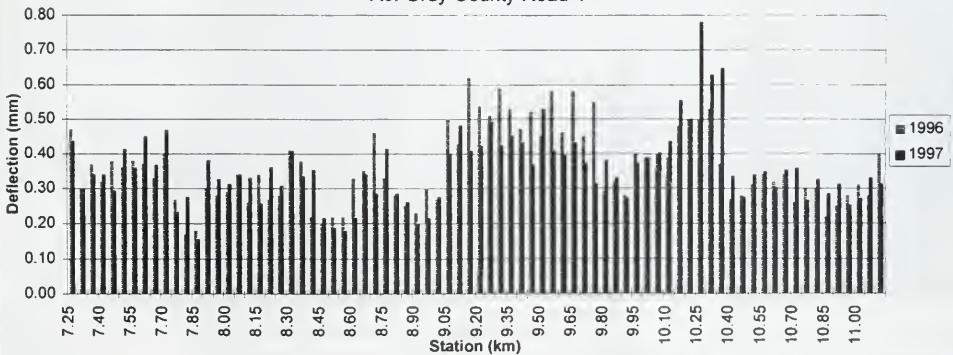
FWD Deflection
A3. Grey County Road 4

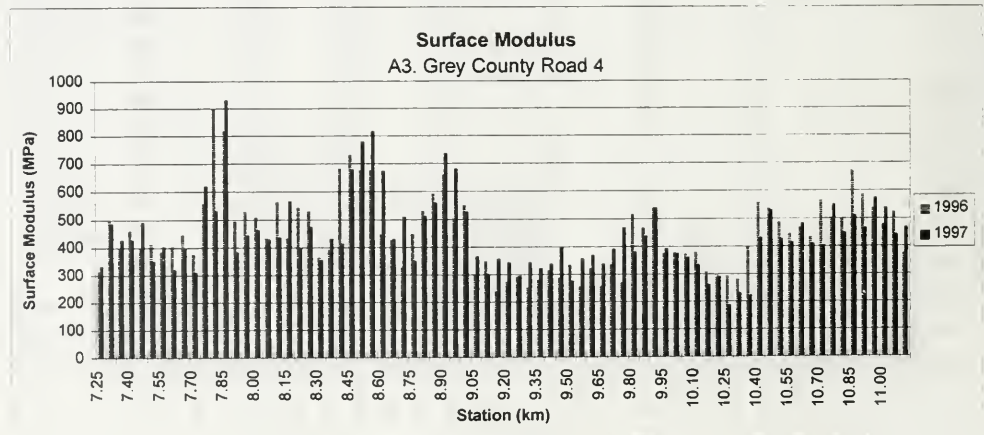
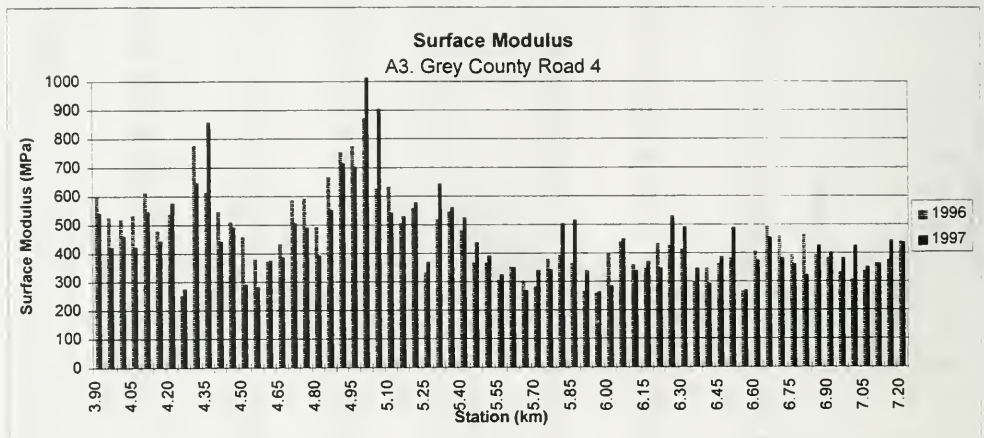
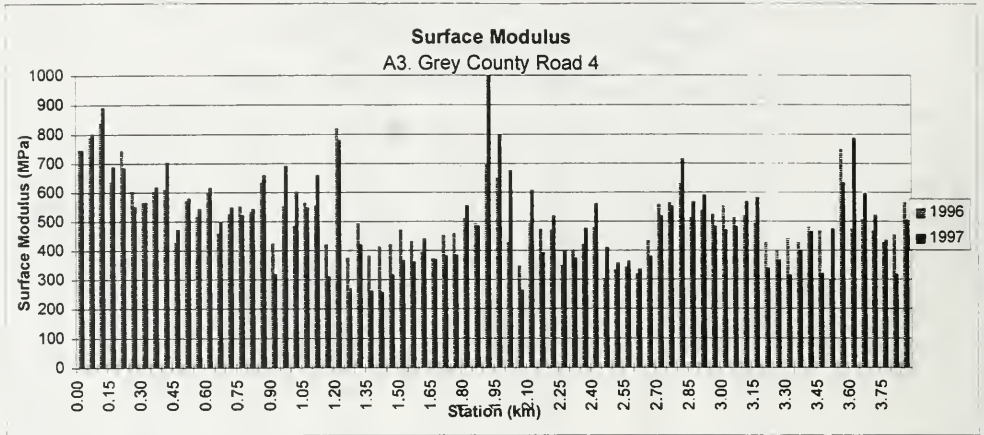


FWD Deflection
A3. Grey County Road 4



FWD Deflection
A3. Grey County Road 4







1996
Photograph A3-1a
Station 1+950.
medium severity
transverse crack.
[07/02/96. SR]



1997
Photograph A3-1b
Station 2+000 looking
east, alligator
cracking in both lanes
and construction joint
crack.
[05/26/97. PP]

Photograph A3-1 Grey County Road 4 (1993 section, Dry Process). No notable difference in distress frequency or severity from 1996 to 1997.

1996



Photograph A3-2 Grey County Road 4 at 3+400 looking east. Note conventional hot-mix asphalt patch areas and medium severity construction joint crack. [07/02/96, SR]

1997



Photograph A3-3 Grey County Road 4 at 10+720 looking north. Localized ravelling in northbound lane and low severity construction joint crack. [05/26/97, PP]

A4. Grey County Road 13

Location: Highway 4 to Eugenia, 2.7 km.

Construction Date: August 14-20, 1992

Contractor: MSO Construction

Plant: Cold In-Place Paving Train

CRM Source: Recovery Technologies, #4 mesh

CRM Amount: 7000 tire equivalent

Mix: 75 mm emulsion RMA modified cold in-place mix with conventional 50 mm
HMA overlay (HL 4)

Distress Summary:

Distress Type	Year					
	1996			1997		
	Low	Moderate	High	Low	Moderate	High
Longitudinal (m)	3	0	0	3	0	0
Transverse (m)	56	21	0	56	21	0
Construction Joint (m)	20	0	0	20	0	0
Meandering (m)	51	0	0	51	0	0
Alligator (m ²)	0	0	0	0	0	0
Edge (m)	493	0	0	943	0	0
Ravelling (m ²)	50	0	0	50	0	0
Patching (m ²)	0	0	0	0	0	0
Potholes	0	0	0	0	0	0
PCI	97			96		

Comments: RMA in base course only; surface in generally good condition.

Detailed Pavement Distresses for 1996

Station	Pavement Distress Type													Remarks	
	Cracks														
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)		Patching (m ²)
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low			
0+360															SBL
0+433		7													NBL
0+880	4														NBL
0+885					3										SBL
0+900							40								NBL
0+900	4														NBL
0+909	4														NBL
1+100															NBL
1+125	7														NBL
1+280	4														NBL
1+360	4														NBL
1+410		7													NBL
1+500		7													NBL
1+520							130								NBL-OWP*
1+600				25									49		SBL-OWP
1+710				2											SBL-OWP
1+730															NBL
1+820				10			8								SBL-OWP
1+890				2											SBL-OWP
1+920	7														NBL
2+000							30								NBL
2+070							135								NBL
2+238				12											NBL
2+290															NBL
2+420	7														NBL
2+440												10			NBL
2+670															NBL
2+690							20								NBL
2+705	7.5														NBL
2+705	7														NBL
2+860												10			End
Total, 1996															
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Ravelling	Patching
	56	21	0	51	0	3	0	493	0	0	0	20	0	50	0

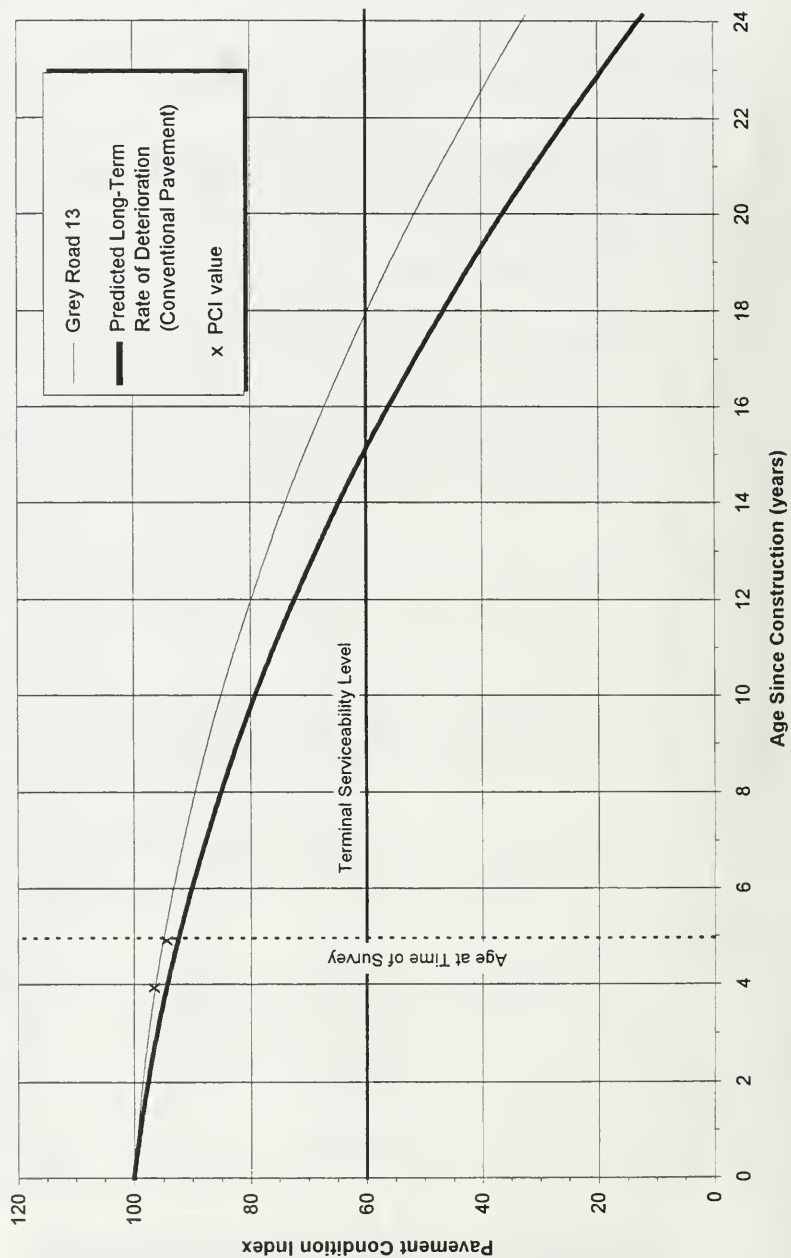
Note: * OWP = Outside Wheelpath.

Detailed Pavement Distresses for 1997

Station	Pavement Distress Type															Remarks	
	Cracks																
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)		Patching (m ²)		
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Low		Low
0+360															1		SBL
0+433		7															NBL
0+880	4																NBL
0+885					3												SBL
0+900							40										NBL
0+900	4																NBL
0+909	4																NBL
1+100																	NBL
1+125	7																NBL
1+280	4																NBL
1+360	4																NBL
1+410		7															NBL
1+500		7															NBL
1+520																	NBL
1+600				25						130					49		NBL-OWP *
1+710			2														SBL-OWP
1+730																	SBL-OWP
1+820				10					8								NBL
1+890			2														SBL-OWP
1+920	7																SBL-OWP
2+000																	NBL
2+070										30							NBL
2+238				12						135							NBL
2+290																	NBL
2+420	7																NBL
2+440													10				NBL
2+670																	NBL
2+690										20							NBL
2+705	7.5									450							NBL
2+705	7																NBL
2+860																	NBL
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Note: * OWP = Outside Wheelpath.

Pavement Life-Cycle Modelling A4. Grey Road 13



PAVEMENT DEFLECTION ANALYSIS RESULTS

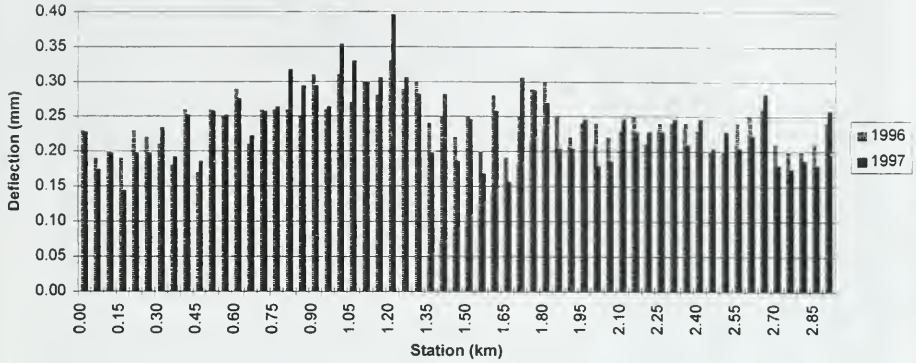
A4. GREY COUNTY ROAD 13

Hwy 4 to Eugenia

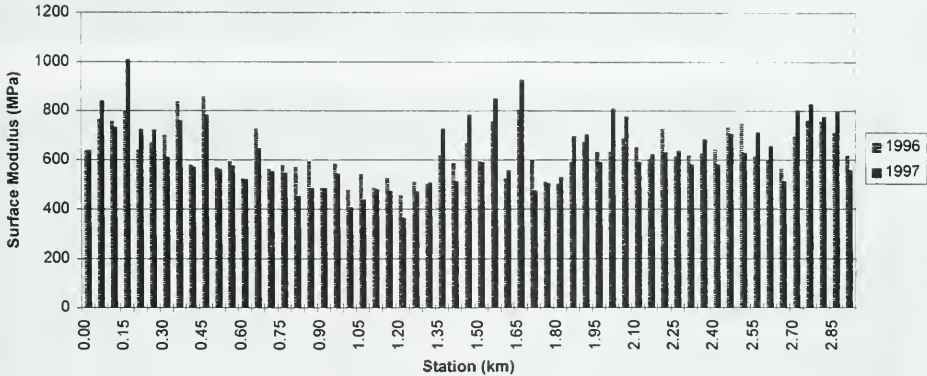
Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
0.00	NBL	0.23	0.38	0.23	637	397	640
0.05	SBL	0.19	0.29	0.17	767	522	842
0.10	NBL	0.20	0.33	0.20	757	455	734
0.15	SBL	0.19	0.24	0.14	799	626	1010
0.20	NBL	0.23	0.33	0.20	639	450	726
0.25	SBL	0.22	0.33	0.20	674	448	723
0.30	NBL	0.21	0.39	0.23	700	379	611
0.35	SBL	0.18	0.32	0.19	839	471	760
0.40	NBL	0.26	0.42	0.25	582	354	571
0.45	SBL	0.17	0.31	0.19	861	486	784
0.50	NBL	0.26	0.43	0.26	568	348	561
0.55	SBL	0.25	0.42	0.25	597	357	576
0.60	NBL	0.29	0.46	0.28	522	323	521
0.65	SBL	0.21	0.37	0.22	725	401	647
0.70	NBL	0.26	0.43	0.26	567	343	553
0.75	SBL	0.26	0.44	0.26	577	339	547
0.80	NBL	0.26	0.53	0.32	572	281	453
0.85	SBL	0.25	0.49	0.29	594	301	485
0.90	NBL	0.31	0.49	0.29	487	301	485
0.95	SBL	0.26	0.44	0.26	584	337	544
1.00	NBL	0.31	0.59	0.35	479	253	408
1.05	SBL	0.27	0.55	0.33	543	272	439
1.10	NBL	0.30	0.5	0.30	489	298	481
1.15	SBL	0.28	0.51	0.31	525	293	473
1.20	NBL	0.33	0.66	0.40	456	226	365
1.25	SBL	0.29	0.51	0.31	510	292	471
1.30	NBL	0.30	0.47	0.28	502	314	506
1.35	SBL	0.24	0.33	0.20	619	451	727
1.40	NBL	0.25	0.47	0.28	587	318	513
1.45	SBL	0.22	0.31	0.19	668	486	784
1.50	NBL	0.25	0.41	0.25	595	366	590
1.55	SBL	0.20	0.28	0.17	760	528	852
1.60	NBL	0.28	0.43	0.26	523	345	556
1.65	SBL	0.19	0.26	0.16	804	575	927
1.70	NBL	0.25	0.51	0.31	599	294	474
1.75	SBL	0.29	0.48	0.29	511	312	503
1.80	NBL	0.30	0.45	0.27	501	328	529
1.85	SBL	0.25	0.34	0.20	591	432	697
1.90	NBL	0.22	0.34	0.20	673	436	703
1.95	SBL	0.24	0.41	0.25	631	367	592
2.00	NBL	0.24	0.3	0.18	631	502	810
2.05	SBL	0.22	0.31	0.19	687	482	777
2.10	NBL	0.23	0.41	0.25	653	367	592

Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
2.15	SBL	0.25	0.38	0.23	604	387	624
2.20	NBL	0.21	0.38	0.23	725	391	631
2.25	SBL	0.24	0.38	0.23	614	395	637
2.30	NBL	0.24	0.41	0.25	617	360	581
2.35	SBL	0.24	0.35	0.21	625	424	684
2.40	NBL	0.23	0.41	0.25	644	360	581
2.45	SBL	0.20	0.34	0.20	731	438	706
2.50	NBL	0.20	0.38	0.23	748	390	629
2.55	SBL	0.24	0.34	0.20	614	442	713
2.60	NBL	0.25	0.37	0.22	600	407	656
2.65	SBL	0.26	0.47	0.28	565	318	513
2.70	NBL	0.21	0.3	0.18	695	498	803
2.75	SBL	0.20	0.29	0.17	761	514	829
2.80	NBL	0.20	0.31	0.19	755	481	776
2.85	SBL	0.21	0.3	0.18	712	495	798
2.90	NBL	0.24	0.43	0.26	616	345	556
Mean		0.24	0.40	0.24	631	392	632
Standard Deviation		0.04	0.09	0.05	96	85	137
Coefficient of Variation		15.0	21.7	21.7	15.3	21.7	21.7

FWD Deflection
A4. Grey County Road 13



Surface Modulus
A4. Grey County Road 13



1996

Photograph A4-1a
Station 0+110 from
south project limit,
medium severity
transverse crack.
[06/27/96, MB]



1997

Photograph A4-1b
Station 0+110, same
transverse crack as
above from opposite
side of road.
[05/26/97, PP]



Photograph A4-1 Grey County Road 13 (1992 section, Dry Cold-In-Place). Very little change in condition of crack between 1996 and 1997.

1996



Photograph A4-2 Grey County Road 13 at Station 0+125 from south project limit. Low to medium severity edge cracking in northbound lane. [06/27/96, MB]

1997



Photograph A4-3 Grey County Road 13 at Station 0+350 from south project limit. Low severity edge cracking in northbound lane. [05/26/97, PP]

A5. Grey County Road 12

Location: Highway 6 to 2.5 km west of Markdale.

Construction Date: May 4-July 24, 1992

Contractor: The Murray Group

CRM Source: Baker Rubber Company, #10 mesh

CRM Amount: 135 tonnes (33,000 tires)

Mix: HL 4, 8769 tonnes

Distress Summary:

Distress Type	Year					
	1996			1997		
	Low	Moderate	High	Low	Moderate	High
Longitudinal (m)	0	0	0	0	0	0
Transverse (m)	249	0	0	256	0	0
Construction Joint (m)	2384	0	0	2384	0	0
Meandering (m)	909	90	0	959	90	0
Alligator (m ²)	136	0	0	714	30	0
Edge (m)	12031	190	0	12521	190	0
Ravelling (m ²)	200	0	0	200	0	0
Patching (m ²)	0	0	0	0	0	0
Potholes	0	0	0	0	0	0
PCI		87			87	

Comments: Generally in good condition.

Rubber Modified Asphalt Detailed Pavement Monitoring Sections
A5, Grey County Road 12 from Hwy 6 to Markdale

Detailed Pavement Distresses for 1996

Station	Pavement Distress Type														Remarks	
	Cracks															
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)			
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low		Moderate
0+000							480									
0+130				1						3						
0+200										5						
0+300														200		
0+400							360									
0+530	3.5															
0+550																
0+550												20				
0+800	5.5															
1+000																
1+000							60					100				
1+250												2				
1+300												3				
1+400												10				
1+510												4				
1+600							240					50				
1+690				5												EBL
1+800												20				
1+850												5				
1+900							825									EBL
1+900							935									WBL
1+970	2															EBL
2+100												110				EBL
2+200											40					
2+320	7															EBL-OWP
2+410										3						EBL-OWP
2+470										20						EBL-OWP
2+566										10						EBL-OWP
2+605										20						EBL-OWP
2+650												15				
2+870				5												EBL
2+975												10				
3+050				2												EBL
3+220										12						EBL-OWP

Detailed Pavement Distresses for 1996

Detailed Pavement Distresses for 1990															Remarks
Station	Pavement Distress Type														
	Cracks														
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)	Patching (m ²)	
Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Low	
3+285													20		WBL
3+300							350								EBL
3+320							340								
3+320												20			
3+420															WBL
3+460					90										EBL
3+500				30											multiple
3+612				20								70			WBL
3+630				30											EBL
3+700													30		
3+870													100		
4+080	7														
4+220				2											EBL
4+230				2											WBL
4+240												60			
4+280							240								EBL
4+400												150			
4+600							150								WBL
4+620	7														
4+730				6											
4+800	3.5														WBL
4+840												30			
4+900							30								WBL
4+910				5											WBL
4+950				10											
5+100												4			
5+105												80			
5+110	7			5											WBL
5+150							100								EBL
5+160	7														
5+165	7														
5+175	7														
5+185	7														

A5. Grey County Road 12 from Hwy 6 to Markdale

Detailed Pavement Distresses for 1996

Station	Pavement Distress Type														Remarks			
	Cracks																	
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)			Patching (m ²)		
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low		Moderate	Low	Moderate
5+300	7																	WBL
5+350	3.5																	EBL
5+375																		WBL
5+400																		WBL
5+550										300								WBL
5+750										150								WBL
5+820										188								WBL
5+900																		EBL
5+910																		EBL
6+000																		EBL
6+050																		WBL
6+090																		WBL
6+100																		
6+130	7																	
6+150																		multiple
6+250																		WBL
6+525																		EBL
6+530																		
6+700																		WBL
6+780																		EBL
6+825																		WBL
6+900																		WBL
7+075																		WBL
7+100																		EBL
7+130	3.5																	WBL
7+180																		WBL
7+190	3.5																	WBL
7+310																		WBL
7+470																		EBL
7+550																		WBL
7+570																		
7+625																		EBL
7+650																		WBL

Detailed Pavement Distresses for 1996

Station	Pavement Distress Type														Remarks
	Cracks														
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)	Patching (m ²)	
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	
7+680										23					EBL
7+960	7								180						EBL
8+000												100			EBL
8+000															WBL
8+060	3.5														WBL
8+130	3.5											30			WBL
8+170															
8+200															
8+240	3.5							433							WBL
8+270												40			WBL
8+300	7														
8+450	7														
8+470								104				20			WBL
8+480															
8+510	7														
8+570	7														
8+585	7														
8+600	7														
8+615	7				10										
8+630															
8+670	7											160			EBL
8+710										90					
8+830	7														
8+890															
8+940												10			WBL
9+000										60					
9+025	7							1330							
9+028	7														
9+040	7														
9+050												30			
9+120															
9+170	1							304							WBL
9+185															WBL

A5. Grey County Road 12 from Hwy 6 to Markdale

Detailed Pavement Distresses for 1996

Station	Pavement Distress Type															Remarks
	Cracks															
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)	Patching (m ²)		
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Low	
9+240																EBL
9+290	3.5											5				WBL
9+395				15												EBL
9+535	3.5															
9+585												15				
9+650												245				
9+850								30								WBL
9+950								50								WBL
10+090	7															
10+110												40				
10+150							170									WBL
10+225												10				
10+400												50				
10+450								150								EBL
10+520												100				
10+555	3.5															WBL
10+680							165					30				
10+700	3.5															WBL
10+720								80								WBL
10+810																
10+900							320					50				WBL
10+950							150									EBL
11+000																
11+040	7											6				
11+200																EBL
11+220							40									
11+240							220	10								
11+400							680					10				
11+550																
11+700												10				
11+740							375									
12+000												10				
12+070												20				

A5. Grey County Road 12 from Hwy 6 to Markdale

Detailed Pavement Distresses for 1996

Station	Pavement Distress Type															Remarks
	Cracks															
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)	Patching (m ²)		
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Low	
12+070				5												WBL
12+100												10				
12+200												50				WBL
12+230				5												
12+235	7															
12+260	3.5															
12+268	2															
12+275												15				
12+285	7															
12+294	3.5															
12+446																End
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Ravelling	Patching	
Total, 1996	249	0	0	909	90	0	12031	190	136	0	2384	0	200	0	0	

Rubber Modified Asphalt Detailed Pavement Monitoring Sections
A5. Grey County Road 12 from Hwy 6 to Markdale

Detailed Pavement Distresses for 1997

Detailed Pavement Distresses for 1997																Remarks
Station	Pavement Distress Type															
	Cracks															
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)	Patching (m ²)		
Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Low	Low	
0+000								480								
0+130				1						3						
0+200										5						
0+300														200		
0+400								360		3						
3.5																
0+530																
0+550																
0+800																
1+000								60					20			
1+250													100			
1+300													2			
1+400													3			
1+510													10			
1+600													4			
1+650								240					50			
1+690																
1+800				5									30			EBL
1+850																
1+900													20			
1+900													5			EBL
1+970								825								EBL
2+100								935								WBL
2+200	2															EBL
2+200								40					110			EBL
2+260										60						EBL
2+320	7							40								EBL
2+410																EBL-OWP
2+470										3						EBL-OWP
2+500										20						EBL-OWP
2+566										25						EBL-OWP
2+605										10						EBL-OWP
2+630										20						EBL-OWP
2+650										40						EBL-OWP
													15			

A5, Grey County Road 12 from Hwy 6 to Markdale

Detailed Pavement Distresses for 1997

Station	Pavement Distress Type																Remarks
	Cracks																
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)	Patching (m ²)			
Low	Moderate	High	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate		
2+870				5												EBL	
2+880																	
2+900								120								WBL	
2+975											10						
3+000								65								EBL	
3+050				2												EBL	
3+200										15						EBL	
3+220										12						EBL-OWP	
3+285											20						
3+300																WBL	
3+320								350								EBL	
3+360								340			20						
3+390																EBL	
3+420					90											WBL	
3+460				30												EBL	
3+490																multiple WBL EBL	
3+500										100							
3+612				20							70						
3+630				30												EBL	
3+700											30						
3+870											100						
4+080	7																
4+220				2												EBL	
4+230				2												WBL	
4+240											60						
4+280								240								EBL	
4+350								50									
4+400											150						
4+490								60								EBL	
4+600								150								WBL	
4+620	7																
4+730				6													

A5, Grey County Road 12 from Hwy 6 to Markdale

Detailed Pavement Distresses for 1997

Station	Pavement Distress Type														Remarks	
	Cracks															
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Raveling (m ²)	Patching (m ²)		
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low		Low
4+800	3.5															WBL
4+840												30				WBL
4+900								30								WBL
4+910				5												
4+950				10												
5+100																
5+105	7															
5+110				5												WBL
5+150								100								EBL
5+160	7															
5+165	7															
5+175	7															
5+185	7															
5+300	7															
5+350	3.5															WBL
5+375														5		WBL
5+380						30										EBL
5+400								300								EBL
5+550								150								WBL
5+750								188								WBL
5+820				5												WBL
5+900								880								EBL
5+910				10												EBL
5+950										5						EBL
5+980								60		50						EBL
6+000													50			
6+050				75												EBL
6+090				20												WBL
6+100													50			
6+125	7															
6+130	7															
6+150				400												multiple
6+200				50												

A5. Grey County Road 12 from Hwy 6 to Markdale

Detailed Pavement Distresses for 1997

Station	Pavement Distress Type														Remarks
	Cracks														
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)	Patching (m ²)	
Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Low	
6+250								272							WBL
6+290									30						EBL
6+525				65											
6+530											30				
6+540									60						
6+690									50						
6+700								225							WBL
6+780				20											EBL
6+825				5											WBL
6+880									20						WBL
6+900				60											WBL
6+920									25						WBL
6+990									15						EBL
7+020								490							WBL
7+100								720							EBL
7+130	3.5														WBL
7+180											60				WBL
7+190	3.5														WBL
7+310				5											EBL
7+470															WBL
7+550				5							40				WBL
7+570															
7+600											160				
7+625				20					10						EBL
7+650				60											WBL
7+680									23						EBL
7+960	7														
8+000									180						EBL
8+000											100				
8+060	3.5														WBL
8+130	3.5														WBL
8+170															
8+200								433			30				

A5. Grey County Road 12 from Hwy 6 to Markdale

Detailed Pavement Distresses for 1997

Station	Pavement Distress Type															Remarks			
	Cracks																		
	Transverse (m)			Meandering (m)			Longitudinal (m)			Edge (m)			Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)	Patching (m ²)	
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	Low				Moderate
8+225																			EBL
8+240	3.5																		WBL
8+270																40			
8+300	7																		
8+450	7																		
8+470										104									WBL
8+480																20			
8+510	7																		
8+570	7																		
8+585	7																		
8+600	7			10															
8+615	7																		
8+630																160			
8+670	7																		
8+710										90									EBL
8+830	7																		
8+890																10			
8+940										60									WBL
9+000										1330									
9+025	7																		
9+028	7																		
9+040	7																		
9+050																			
9+120																30			
9+170	1									304									WBL
9+185				1															WBL
9+240																5			WBL
9+290	3.5																		WBL
9+395				15															EBL
9+535	3.5																		WBL
9+585																15			EBL
9+650																245			
9+850										30									WBL

A5. Gray County Road 12 from Hwy 6 to Markdale

Detailed Pavement Distresses for 1997

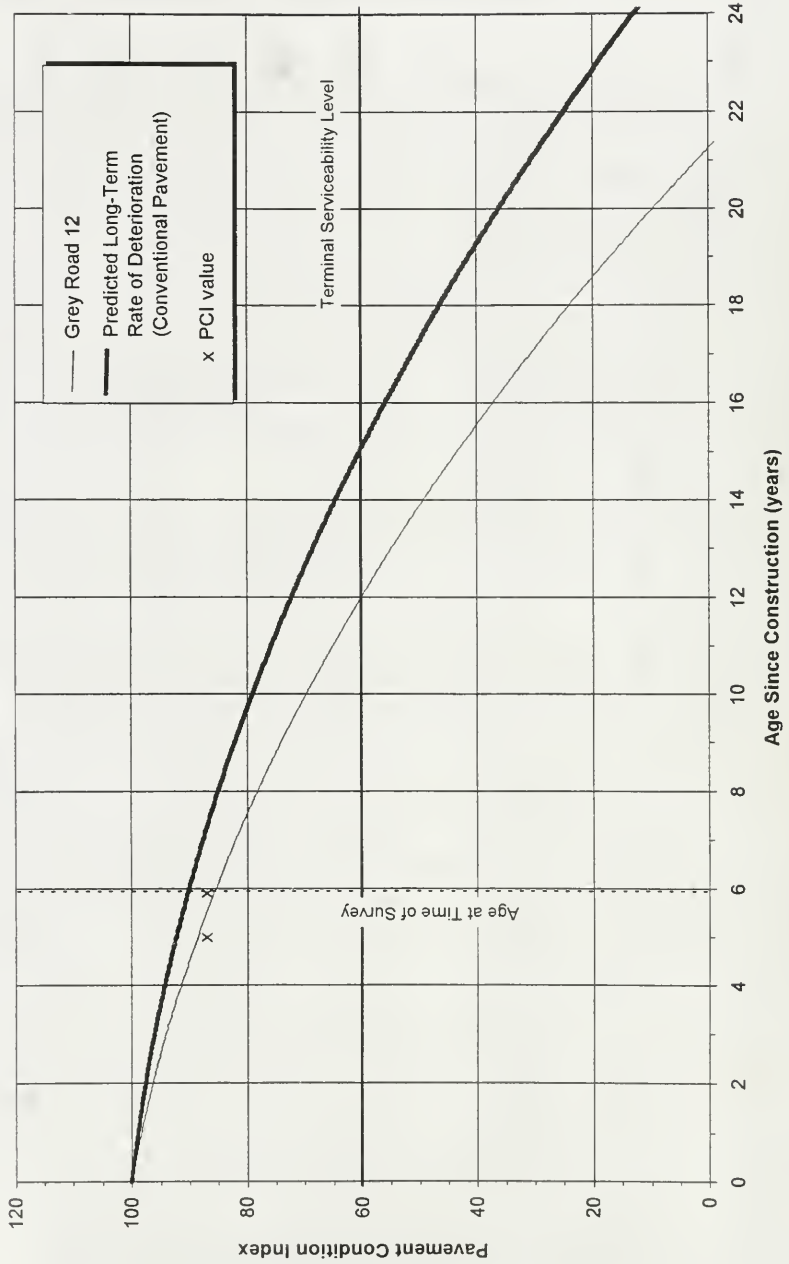
Station	Pavement Distress Type															Remarks	
	Cracks																
	Transverse (m)			Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)	Patching (m ²)		
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate				Low
9+950																	
10+090	7									50							WBL
10+110																	
10+150										170			40				WBL
10+225													10				
10+400													50				EBL
10+450										150							
10+520													100				WBL
10+555	3.5																WBL
10+680										165			30				WBL
10+700	3.5																WBL
10+720										80							WBL
10+810													50				WBL
10+900										320							EBL
10+950										150							EBL
11+000													6				
11+040	7																EBL
11+200										40							
11+220										220	10						
11+240													10				
11+400										680							
11+550													10				
11+700													10				
11+740										375							
12+000													10				
12+070													20				WBL
12+070				5													
12+100													10				
12+200													50				
12+230				5													WBL
12+235	7																
12+260	3.5																WBL
12+268	2																

A5. Grey County Road 12 from Hwy 6 to Markdale

Detailed Pavement Distresses for 1997

Station	Pavement Distress Type															Remarks		
	Cracks																	
	Transverse (m)			Meandering (m)			Longitudinal (m)			Edge (m)			Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)	Patching (m ²)
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate				
12+275															15	Low	Low	
12+285	7																	
12+294	3.5																	
12+446																		End
Total, 1997	Transverse			Meandering			Longitudinal			Edge			Alligator		Construction Joint		Ravelling	Patching
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	Low	Moderate		
	256	0	0	959	90	30	0	12521	190	714	30	2384	0	200	0			

Pavement Life-Cycle Modelling
A5. Grey Road 12



PAVEMENT DEFLECTION ANALYSIS RESULTS
 A5. GREY COUNTY ROAD 12
 Hwy 6 to 12.5 km East

Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
0.00	WBL	0.27	0.60	0.30	547	248	496
0.05	EBL	0.29	0.49	0.25	510	305	610
0.10	WBL	0.29	0.79	0.40	518	189	378
0.15	EBL	0.34	0.44	0.22	441	342	684
0.20	WBL	0.19	0.39	0.20	767	386	772
0.25	EBL	0.35	0.81	0.41	425	184	368
0.30	WBL	0.32	0.78	0.39	471	190	380
0.35	EBL	0.33	0.65	0.33	455	231	462
0.40	WBL	0.36	0.76	0.38	411	197	394
0.45	EBL	0.28	0.50	0.25	530	296	592
0.50	WBL	0.25	0.54	0.27	599	277	554
0.55	EBL	0.27	0.55	0.28	542	272	544
0.60	WBL	0.20	0.48	0.24	750	313	626
0.65	EBL	0.23	0.34	0.17	661	436	872
0.70	WBL	0.24	0.56	0.28	630	264	528
0.75	EBL	0.34	0.46	0.23	435	322	644
0.80	WBL	0.26	0.52	0.26	574	286	572
0.85	EBL	0.31	0.55	0.28	475	271	542
0.90	WBL	0.26	0.66	0.33	576	226	452
0.95	EBL	0.32	0.65	0.33	464	229	458
1.00	WBL	0.24	0.73	0.37	620	204	408
1.05	EBL	0.23	0.37	0.19	642	400	800
1.10	WBL	0.29	0.59	0.30	521	251	502
1.15	EBL	0.37	0.50	0.25	399	298	596
1.20	WBL	0.22	0.44	0.22	692	336	672
1.25	EBL	0.33	0.60	0.30	457	248	496
1.30	WBL	0.22	0.56	0.28	670	268	536
1.35	EBL	0.27	0.51	0.26	542	294	588
1.40	WBL	0.24	0.43	0.22	626	344	688
1.45	EBL	0.29	0.56	0.28	515	265	530
1.50	WBL	0.25	0.46	0.23	598	321	642
1.55	EBL	0.35	0.48	0.24	426	309	618
1.60	WBL	0.25	0.50	0.25	606	295	590
1.65	EBL	0.29	0.54	0.27	518	278	556
1.70	WBL	0.18	0.49	0.25	813	306	612
1.75	EBL	0.50	0.85	0.43	299	176	352
1.80	WBL	0.30	0.78	0.39	491	191	382
1.85	EBL	0.23	0.55	0.28	634	270	540
1.90	WBL	0.28	0.56	0.28	526	268	536
1.95	EBL	0.35	0.54	0.27	422	275	550
2.00	WBL	0.29	0.43	0.22	510	343	686
2.05	EBL	0.30	0.61	0.31	494	245	490
2.10	WBL	0.23	0.54	0.27	637	278	556
2.15	EBL	0.31	0.55	0.28	484	271	542
2.20	WBL	0.26	0.54	0.27	584	276	552

Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
2.25	EBL	0.36	0.63	0.32	412	237	474
2.30	WBL	0.32	0.72	0.36	463	206	412
2.35	EBL	0.33	0.64	0.32	452	233	466
2.40	WBL	0.25	0.65	0.33	590	228	456
2.45	EBL	0.31	0.55	0.28	482	269	538
2.50	WBL	0.27	0.59	0.30	544	251	502
2.55	EBL	0.31	0.73	0.37	485	203	406
2.60	WBL	0.28	0.67	0.34	537	221	442
2.65	EBL	0.35	0.68	0.34	427	219	438
2.70	WBL	0.28	0.59	0.30	529	251	502
2.75	EBL	0.43	0.87	0.44	343	171	342
2.80	WBL	0.26	0.81	0.41	568	183	366
2.85	EBL	0.29	0.55	0.28	520	269	538
2.90	WBL	0.29	0.75	0.38	523	198	396
2.95	EBL	0.50	0.62	0.31	299	239	478
3.00	WBL	0.25	0.57	0.29	607	263	526
3.05	EBL	0.29	0.58	0.29	512	258	516
3.10	WBL	0.40	0.72	0.36	376	208	416
3.15	EBL	0.41	0.81	0.41	360	184	368
3.20	WBL	0.41	0.75	0.38	367	198	396
3.25	EBL	0.34	0.70	0.35	439	211	422
3.30	WBL	0.33	0.69	0.35	455	215	430
3.35	EBL	0.31	0.52	0.26	480	288	576
3.40	WBL	0.25	0.57	0.29	603	259	518
3.45	EBL	0.24	0.40	0.20	630	371	742
3.50	WBL	0.27	0.55	0.28	556	271	542
3.55	EBL	0.35	0.71	0.36	429	209	418
3.60	WBL	0.41	0.68	0.34	365	218	436
3.65	EBL	0.44	0.57	0.29	342	262	524
3.70	WBL	0.27	0.56	0.28	556	267	534
3.75	EBL	0.54	0.43	0.22	274	345	690
3.80	WBL	0.33	0.53	0.27	454	283	566
3.85	EBL	0.29	0.53	0.27	513	283	566
3.90	WBL	0.23	0.66	0.33	654	226	452
3.95	EBL	0.33	0.51	0.26	456	290	580
4.00	WBL	0.24	0.53	0.27	620	282	564
4.05	EBL	0.32	0.50	0.25	467	298	596
4.10	WBL	0.23	0.54	0.27	645	275	550
4.15	EBL	0.33	0.49	0.25	448	304	608
4.20	WBL	0.20	0.62	0.31	762	241	482
4.25	EBL	0.41	0.83	0.42	366	179	358
4.30	WBL	0.23	0.85	0.43	656	175	350
4.35	EBL	0.31	0.51	0.26	486	290	580
4.40	WBL	0.32	0.61	0.31	462	244	488
4.45	EBL	0.25	0.47	0.24	594	319	638
4.50	WBL	0.16	0.57	0.29	903	262	524
4.55	EBL	0.29	0.45	0.23	517	333	666
4.60	WBL	0.26	0.65	0.33	563	229	458
4.65	EBL	0.34	0.53	0.27	436	280	560

Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
4.70	WBL	0.36	0.64	0.32	418	232	464
4.75	EBL	0.48	0.70	0.35	310	212	424
4.80	WBL	0.29	0.53	0.27	522	282	564
4.85	EBL	0.24	0.36	0.18	617	410	820
4.90	WBL	0.18	0.44	0.22	811	341	682
4.95	EBL	0.27	0.59	0.30	545	254	508
5.00	WBL	0.24	1.02	0.51	628	147	294
5.05	EBL	0.37	0.76	0.38	400	196	392
5.10	WBL	0.22	0.71	0.36	677	210	420
5.15	EBL	0.26	0.45	0.23	574	327	654
5.20	WBL	0.21	0.41	0.21	713	366	732
5.25	EBL	0.21	0.35	0.18	717	422	844
5.30	WBL	0.26	0.61	0.31	581	246	492
5.35	EBL	0.26	0.58	0.29	564	257	514
5.40	WBL	0.35	0.71	0.36	424	209	418
5.45	EBL	0.42	0.97	0.49	355	154	308
5.50	WBL	0.21	0.56	0.28	727	265	530
5.55	EBL	0.27	0.53	0.27	552	280	560
5.60	WBL	0.33	0.80	0.40	447	187	374
5.65	EBL	0.28	0.51	0.26	528	291	582
5.70	WBL	0.22	0.52	0.26	665	287	574
5.75	EBL	0.27	0.64	0.32	553	233	466
5.80	WBL	0.26	0.61	0.31	575	244	488
5.85	EBL	0.48	1.00	0.50	307	149	298
5.90	WBL	0.43	0.77	0.39	349	193	386
5.95	EBL	0.33	0.93	0.47	450	159	318
6.00	WBL	0.27	0.90	0.45	542	166	332
6.05	EBL	0.29	0.93	0.47	508	161	322
6.10	WBL	0.43	0.70	0.35	350	212	424
6.15	EBL	0.40	1.46*	0.73	373	102	204
6.20	WBL	0.38	0.99	0.50	396	151	302
6.25	EBL	0.52	0.92	0.46	288	161	322
6.30	WBL	0.27	0.82	0.41	543	181	362
6.35	EBL	0.30	0.65	0.33	497	228	456
6.40	WBL	0.20	0.54	0.27	729	275	550
6.45	EBL	0.30	1.06	0.53	500	140	280
6.50	WBL	0.20	0.93	0.47	748	160	320
6.55	EBL	0.19	0.55	0.28	791	269	538
6.60	WBL	0.24	0.57	0.29	611	261	522
6.65	EBL	0.29	0.41	0.21	522	360	720
6.70	WBL	0.17	0.63	0.32	877	236	472
6.75	EBL	0.24	0.57	0.29	624	260	520
6.80	WBL	0.19	0.52	0.26	780	284	568
6.85	EBL	0.29	0.62	0.31	507	242	484
6.90	WBL	0.19	0.56	0.28	779	267	534
6.95	EBL	0.24	0.46	0.23	615	326	652
7.00	WBL	0.20	0.34	0.17	743	439	878
7.05	EBL	0.20	0.30	0.15	737	490	980
7.10	WBL	0.14	0.26	0.13	1040	578	1156

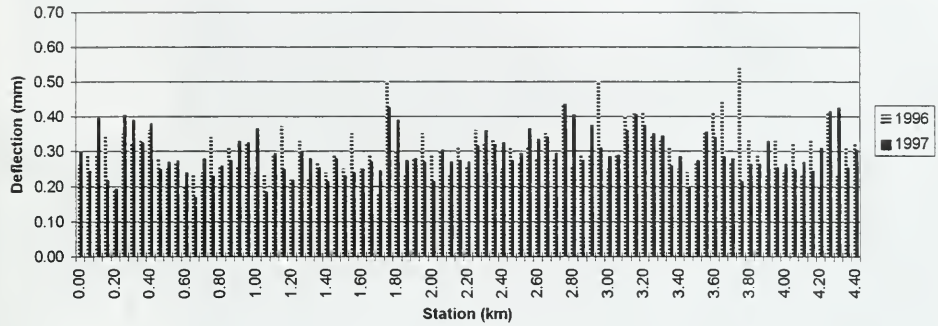
Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
7.15	EBL	0.15	0.28	0.14	1001	530	1060
7.20	WBL	0.20	0.32	0.16	743	470	940
7.25	EBL	0.26	0.64	0.32	573	232	464
7.30	WBL	0.18	0.55	0.28	819	272	544
7.35	EBL	0.23	0.40	0.20	656	374	748
7.40	WBL	0.18	0.36	0.18	836	411	822
7.45	EBL	0.29	0.75	0.38	520	200	400
7.50	WBL	0.17	0.51	0.26	860	291	582
7.55	EBL	0.31	0.39	0.20	488	382	764
7.60	WBL	0.15	0.33	0.17	986	453	906
7.65	EBL	0.29	0.51	0.26	514	294	588
7.70	WBL	0.15	0.43	0.22	1005	350	700
7.75	EBL	0.32	0.65	0.33	471	231	462
7.80	WBL	0.18	0.42	0.21	813	354	708
7.85	EBL	0.28	0.46	0.23	538	323	646
7.90	WBL	0.25	0.48	0.24	589	312	624
7.95	EBL	0.23	0.34	0.17	659	433	866
8.00	WBL	0.24	0.32	0.16	633	466	932
8.05	EBL	0.28	0.59	0.30	523	252	504
8.10	WBL	0.18	0.39	0.20	840	379	758
8.15	EBL	0.24	0.59	0.30	614	252	504
8.20	WBL	0.18	0.52	0.26	822	288	576
8.25	EBL	0.20	0.50	0.25	731	296	592
8.30	WBL	0.17	0.38	0.19	867	390	780
8.35	EBL	0.19	0.36	0.18	768	409	818
8.40	WBL	0.21	0.34	0.17	698	439	878
8.45	EBL	0.27	0.43	0.22	552	346	692
8.50	WBL	0.21	0.44	0.22	695	337	674
8.55	EBL	0.29	0.49	0.25	513	302	604
8.60	WBL	0.19	0.47	0.24	786	318	636
8.65	EBL	0.23	0.38	0.19	661	387	774
8.70	WBL	0.19	0.33	0.17	768	454	908
8.75	EBL	0.33	0.70	0.35	451	213	426
8.80	WBL	0.20	0.60	0.30	745	249	498
8.85	EBL	0.45	0.84	0.42	334	178	356
8.90	WBL	0.29	0.61	0.31	516	246	492
8.95	EBL	0.30	0.69	0.35	493	215	430
9.00	WBL	0.27	0.45	0.23	556	332	664
9.05	EBL	0.25	0.62	0.31	585	239	478
9.10	WBL	0.22	0.56	0.28	681	264	528
9.15	EBL	0.21	0.46	0.23	710	325	650
9.20	WBL	0.20	0.40	0.20	757	375	750
9.25	EBL	0.30	0.55	0.28	496	270	540
9.30	WBL	0.20	0.44	0.22	731	338	676
9.35	EBL	0.25	0.57	0.29	603	261	522
9.40	WBL	0.19	0.44	0.22	799	338	676
9.45	EBL	0.31	0.59	0.30	477	254	508
9.50	WBL	0.33	0.48	0.24	448	311	622
9.55	EBL	0.38	0.90	0.45	392	166	332

Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
9.60	WBL	0.35	0.49	0.25	430	304	608
9.65	EBL	0.31	0.85	0.43	473	175	350
9.70	WBL	0.32	0.61	0.31	471	245	490
9.75	EBL	0.48	0.92	0.46	307	162	324
9.80	WBL	0.39	0.70	0.35	387	212	424
9.85	EBL	0.34	0.49	0.25	439	307	614
9.90	WBL	0.19	0.47	0.24	774	314	628
9.95	EBL	0.44	0.53	0.27	338	281	562
10.00	WBL	0.23	0.55	0.28	655	271	542
10.05	EBL	1.00*	0.68	0.34	148*	219	438
10.10	WBL	0.27	1.19	0.60	558	125	250
10.15	EBL	0.26	0.52	0.26	574	288	576
10.20	WBL	0.38	0.59	0.30	392	254	508
10.25	EBL	0.27	0.64	0.32	542	232	464
10.30	WBL	0.28	0.50	0.25	532	299	598
10.35	EBL	0.35	0.70	0.35	422	212	424
10.40	WBL	0.30	0.66	0.33	492	225	450
10.45	EBL	0.38	0.67	0.34	395	221	442
10.50	WBL	0.32	0.62	0.31	459	242	484
10.55	EBL	0.35	0.70	0.35	426	213	426
10.60	WBL	0.27	0.63	0.32	559	237	474
10.65	EBL	0.29	0.74	0.37	514	202	404
10.70	WBL	0.33	0.68	0.34	448	217	434
10.75	EBL	0.35	0.88	0.44	427	169	338
10.80	WBL	0.32	0.80	0.40	462	187	374
10.85	EBL	0.33	0.54	0.27	450	278	556
10.90	WBL	0.29	0.54	0.27	519	278	556
10.95	EBL	0.29	0.54	0.27	510	274	548
11.00	WBL	0.30	0.61	0.31	491	243	486
11.05	EBL	0.37	0.94	0.47	404	158	316
11.10	WBL	0.26	0.76	0.38	566	196	392
11.15	EBL	0.32	0.66	0.33	464	225	450
11.20	WBL	0.33	0.60	0.30	445	249	498
11.25	EBL	0.33	0.82	0.41	451	182	364
11.30	WBL	0.41	0.77	0.39	365	194	388
11.35	EBL	0.38	0.84	0.42	397	178	356
11.40	WBL	0.35	0.81	0.41	425	184	368
11.45	EBL	0.31	0.49	0.25	487	306	612
11.50	WBL	0.28	0.55	0.28	537	271	542
11.55	EBL	0.33	0.71	0.36	445	210	420
11.60	WBL	0.27	0.59	0.30	548	251	502
11.65	EBL	0.40	0.71	0.36	375	211	422
11.70	WBL	0.32	0.85	0.43	469	175	350
11.75	EBL	0.31	0.64	0.32	483	234	468
11.80	WBL	0.38	0.57	0.29	392	262	524
11.85	EBL	0.38	0.77	0.39	393	194	388
11.90	WBL	0.54	0.84	0.42	274	178	356
11.95	EBL	0.41	0.94	0.47	362	159	318
12.00	WBL	0.47	0.77	0.39	319	194	388

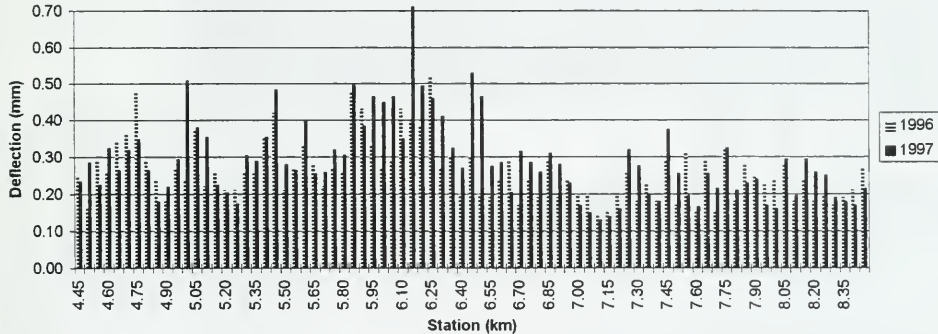
Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
12.05	EBL	0.51	1.28	0.64	294	116	232
12.10	WBL	0.52	1.26	0.63	287	118	236
12.15	EBL	0.57	1.00	0.50	262	149	298
12.20	WBL	0.52	1.14	0.57	285	130	260
12.25	EBL	0.67	1.77*	0.89*	224	84*	168*
12.30	WBL	0.57	1.30	0.65	263	115	230
12.35	EBL	0.55	1.15	0.58	272	130	260
12.40	WBL	0.40	1.00	0.50	376	150	300
12.45	EBL	0.34			440		
Mean		0.30	0.62	0.31	539	262	524
Standard Deviation		0.09	0.19	0.10	152	78.1	156
Coefficient of Variation		29.7	30.2	31.2	28.2	29.8	29.8

Note: * Not included in statistical analysis.

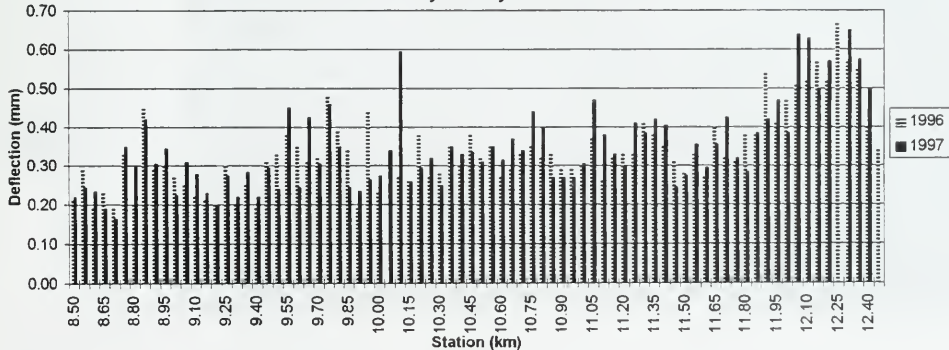
FWD Deflection
A5-Grey County Road 12

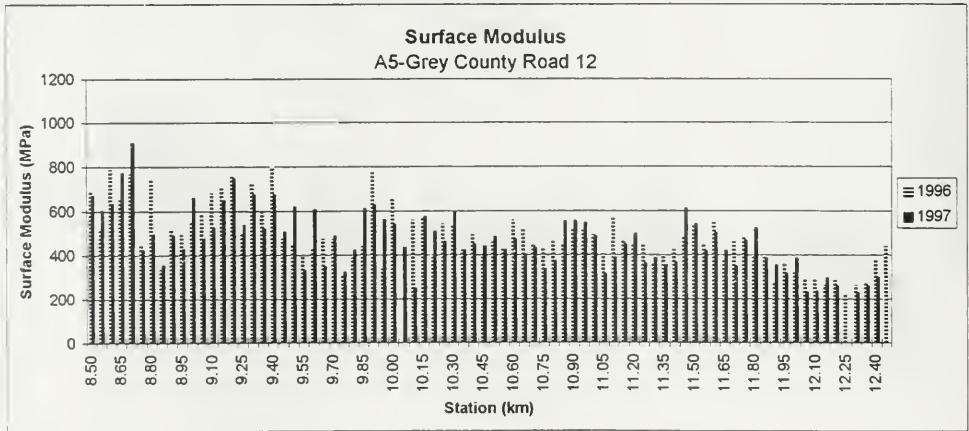
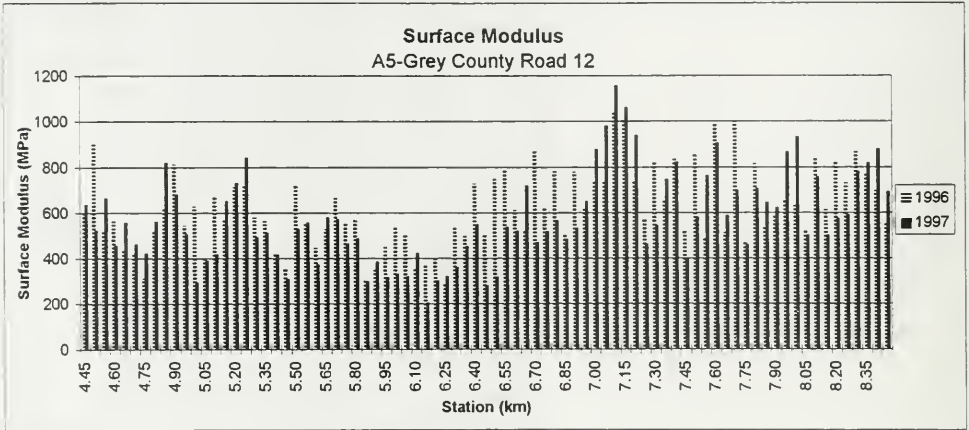
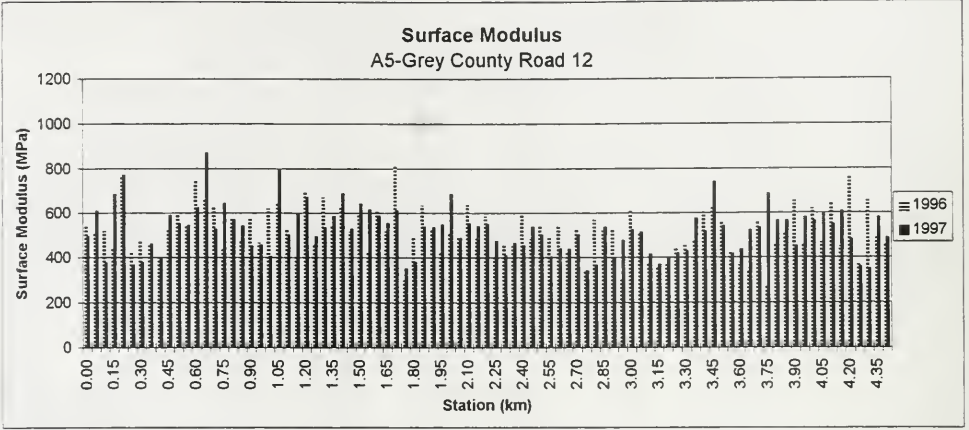


FWD Deflection
A5-Grey County Road 12



FWD Deflection
A5-Grey County Road 12







1996
Photograph A5-1a
Station 6+160,
alligator and
construction joint
cracking.
[06/27/96, MB]



1997
Photograph A5-1b
Station 6+200,
alligator and edge
cracking visible in
both lanes.
[05/26/97, PP]

Photograph A5-1 Grey County Road 12. A slight increase in distress frequency and severity over the entire length was observed between the 1996 and 1997 surveys.

1996



Photograph A5-2 Grey County Road 12 at Station 8+000 looking west. Extensive low severity edge cracks are apparent on both sides of the road. [06/27/96. MB]

1997



Photograph A5-3 Grey County Road 12 at Station 4+900 looking west. Moderate severity edge and some longitudinal cracking. [05/26/97. PP]

A6. City of Peterborough - Armour Road

Location: Parkhill Road to 1.8 km north.

Construction Date: October 5, 1994

Contractor: Northland Bitulithic

Mix Type: Wet: 850 tonnes; A.C. - 85% 150/200 and 15% #60 mesh CRM
(Duratirephalt)

Control: 1150 tonnes; 85/100 A.C. HL 1

Distress Summary:

Distress Type	Year					
	1996			1997		
	Low	Moderate	High	Low	Moderate	High
Longitudinal (m)	244	0	0	246	0	0
Transverse (m)	1272	0	0	1314	0	0
Construction Joint (m)	0	0	0	0	0	0
Meandering (m)	58	0	0	58	0	0
Alligator (m ²)	0	0	0	0	0	0
Edge (m)	0	0	0	0	0	0
Ravelling (m ²)	0	0	0	0	0	0
Patching (m ²)	9	0	0	9	0	0
Potholes	0	0	0	0	0	0
PCI	95			94		

Comments: Both 800 m RMA section and 1 km control section in very good condition. Majority of cracks are hairline and mostly transverse.

Rubber Modified Asphalt Detailed Pavement Monitoring Sections
A6. Peterborough - Armour Road from Parkhill Road to 805m north

Detailed Pavement Distresses for 1996*

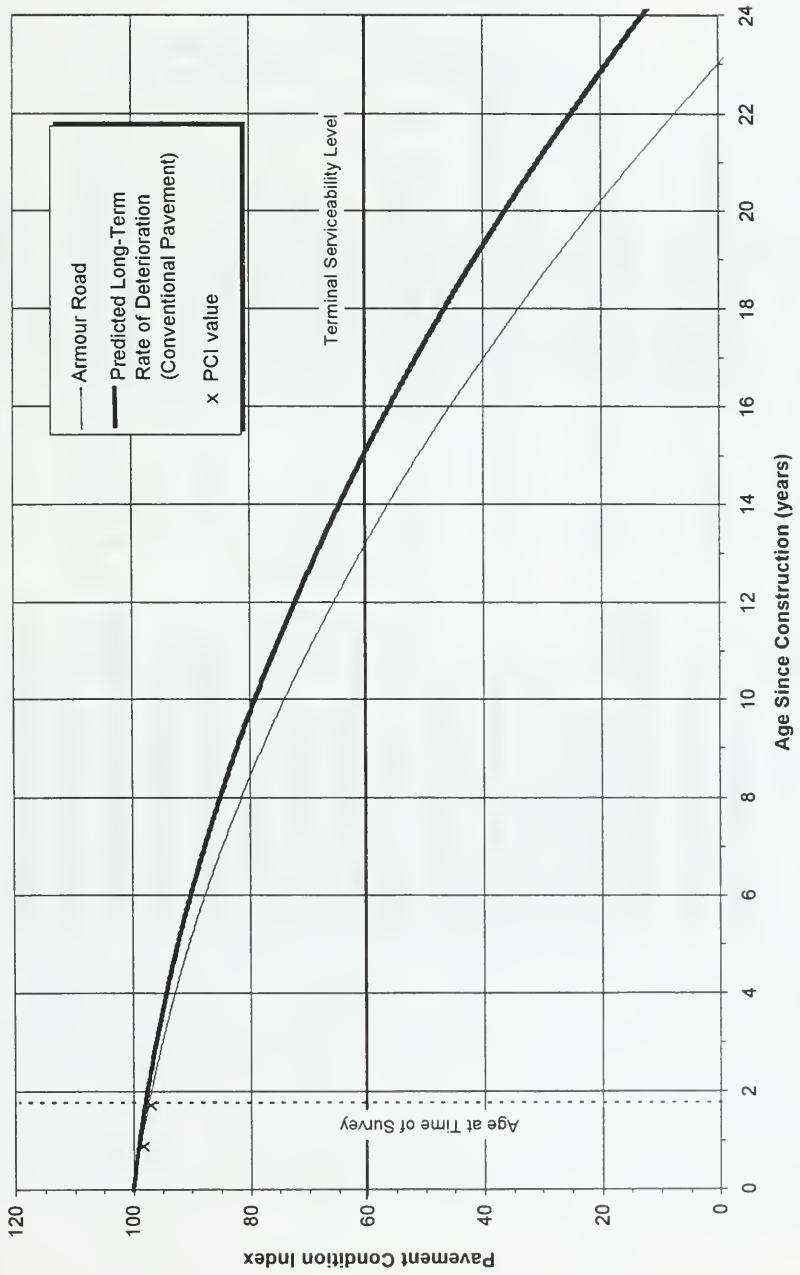
Detailed Pavement Distresses for 1996													Remarks			
Station	Pavement Distress Type															
	Cracks											Patching (m ²)				
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)			Ravelling (m ²)		
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Low	
0+000 to 0+100	47				12											
0+100 to 0+200	95				28											
0+200 to 0+300	110				35											
0+300 to 0+400	154				17											
0+400 to 0+500	206			12	24											
0+500 to 0+600	197			20	71										9	
0+600 to 0+700	207			17	44											
0+700 to 0+800	247				9											
0+800 to 0+805	9															
Total, 1996	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Ravelling	Patching	
	1272	0	0	58	0	244	0	0	0	0	0	0	0	0	9	

Detailed Pavement Distresses for 1997*

Detailed Pavement Distresses for 1997													Remarks
Station	Pavement Distress Type												
	Cracks					Alligator							
	Transverse (m)		Meandering (m)		Longitudinal (m)	Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)	Patching (m ²)
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Low
0+000 to 0+100	52				12								
0+100 to 0+200	98				28								
0+200 to 0+300	110				35								
0+300 to 0+400	169				19								
0+400 to 0+500	215			12	24								
0+500 to 0+600	201			20	71								9
0+600 to 0+700	209			17	44								
0+700 to 0+800	251			9	13								
0+800 to 0+805	9												
	Transverse		Meandering	Longitudinal		Edge		Alligator		Construction Joint		Ravelling	Patching
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Low
Total, 1997	1314	0	0	58	0	246	0	0	0	0	0	0	9

Note: *Refer to Pavement Inspection Forms for distress locations.

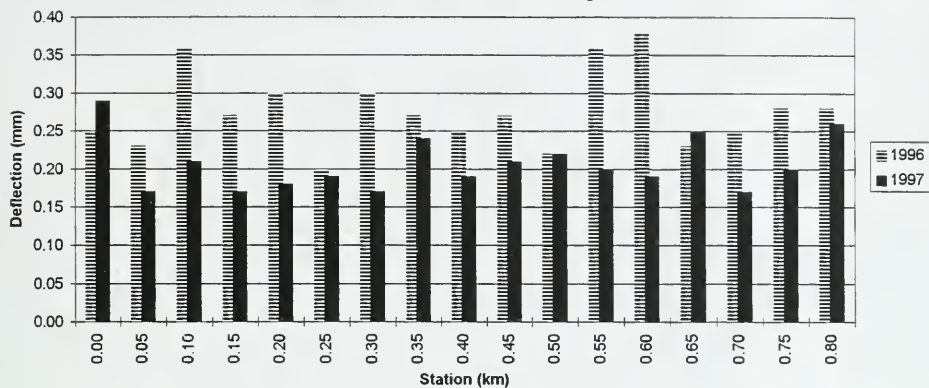
Pavement Life-Cycle Modelling
A6. Armour Road - Peterborough



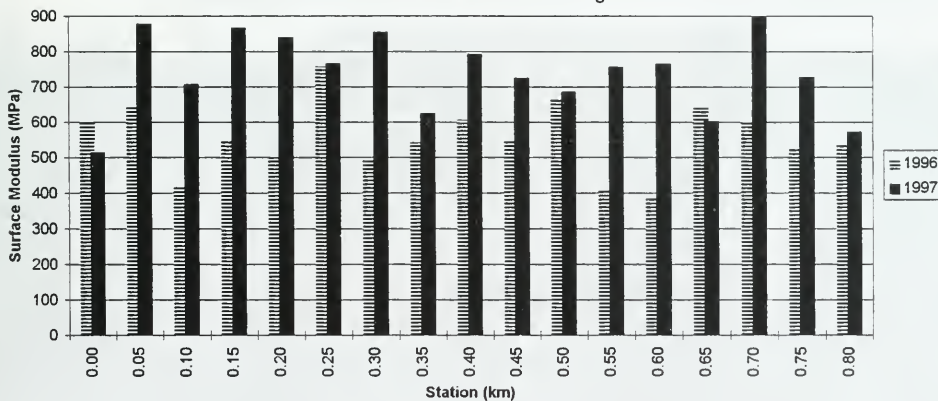
PAVEMENT DEFLECTION ANALYSIS RESULTS
 A6. ARMOUR ROAD, PETERBOROUGH
 Parkhill Road to 805 m north

Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
0.00	NBL	0.25	0.29	0.39	598	515	386
0.05	SBL	0.23	0.17	0.23	643	879	659
0.10	NBL	0.36	0.21	0.28	415	709	532
0.15	SBL	0.27	0.17	0.23	550	867	650
0.20	NBL	0.30	0.18	0.24	500	841	631
0.25	SBL	0.20	0.19	0.25	757	767	575
0.30	NBL	0.30	0.17	0.23	496	856	642
0.35	SBL	0.27	0.24	0.32	543	626	470
0.40	NBL	0.25	0.19	0.25	606	794	596
0.45	SBL	0.27	0.21	0.28	549	726	545
0.50	NBL	0.22	0.22	0.29	667	687	515
0.55	SBL	0.36	0.20	0.27	409	757	568
0.60	NBL	0.38	0.19	0.25	387	767	575
0.65	SBL	0.23	0.25	0.33	641	603	452
0.70	NBL	0.25	0.17	0.23	605	897	673
0.75	SBL	0.28	0.20	0.27	525	729	547
0.80	NBL	0.28	0.26	0.35	534	573	430
Mean		0.28	0.21	0.28	554	741	556
Standard Deviation		0.05	0.04	0.05	98	113	84
Coefficient of Variation		18.4	17.1	17.1	17.6	15.2	15.2

FWD Deflection
A6. Armour Road - Peterborough



Surface Modulus
A6. Armour Road - Peterborough





1996
 Photograph A6-1a
 Station 0+625,
 looking east across
 Armour Road.
 [07/18/96. SR]



1997
 Photograph A6-1b
 Station 0+625, looking
 south from Franmor
 Drive. [07/18/97. PP]

Photograph A6-1 City of Peterborough - Armour Road (1995 section, Wet Process) at 0+625. Frequency of low severity transverse and longitudinal cracking has increased marginally since 1996.



1996
Photograph A6-2a
Station 0+000,
looking north from
Parkhill Road.
[07/18/96. SR]



1997
Photograph A6-2b
Station 0+015,
looking north.
[07/18/97, PP]

Photograph A6-2 City of Peterborough - Armour Road at south end of project. Little change in condition observed since 1996.

A7. Town of Kirkland Lake - Main Street

Location: Birch Street to 325 m south.

Construction Date: September 21, 1994

Contractor: Grant Paving

CRM: #30 mesh, 1.2% by mass

Pavement Structure: 1.5 m Gran. B, 150 mm Gran. A, 80 mm HL 4 RMA

Distress Summary:

Distress Type	1996			1997		
	Low	Moderate	High	Low	Moderate	High
Longitudinal (m)	0	0	0	0	0	0
Transverse (m)	8	0	0	8	0	0
Construction Joint (m)	0	0	0	0	0	0
Meandering (m)	0	0	0	0	0	0
Alligator (m ²)	0	0	0	2	0	0
Edge (m)	0	0	0	12	0	0
Ravelling (m ²)	0	0	0	0	0	0
Patching (m ²)	0	0	0	20	0	0
Depression (m ²)	0	6	0	0	0	0
PCI	96			97		

Note: Depression was patched since the 1996 survey.

Rubber Modified Asphalt Detailed Pavement Monitoring Sections
A7. Kirkland Lake - Main Street from Birch Street to Power Plant

Detailed Pavement Distresses for 1996

Station	Pavement Distress Type											Remarks		
	Cracks													
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Depression (m ²)		Construction Joint (m)			
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low			Moderate	
0+000														
0+199	1													
0+227										6				
0+273	7													
0+325														
	Transverse		Meandering		Longitudinal		Edge		Depression		Construction Joint	Ravelling	Patching	over gas line
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Low	
	8	0	0	0	0	0	0	0	0	6	0	0	0	
Total, 1996														
														End

over gas line
End

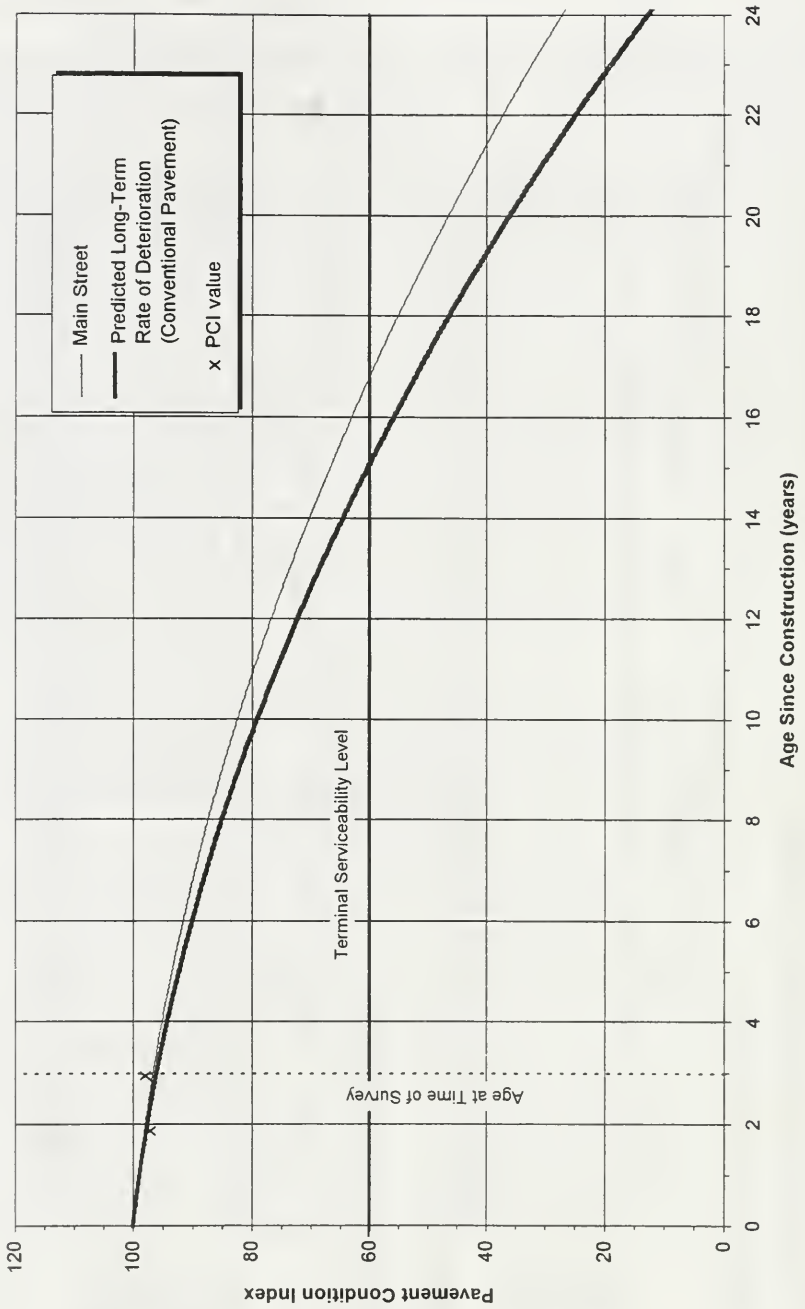
- A85 -

Detailed Pavement Distresses for 1997

Station	Pavement Distress Type											Remarks		
	Cracks													
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)			
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low			Moderate	
0+000														
0+170							12							
0+199	1													
0+227														15*
0+273	7													
0+300										2				
0+325														5
														End

Note: * Patch placed over depression from 1996.

Pavement Life-Cycle Modelling
A7. Main Street - Kirkland Lake



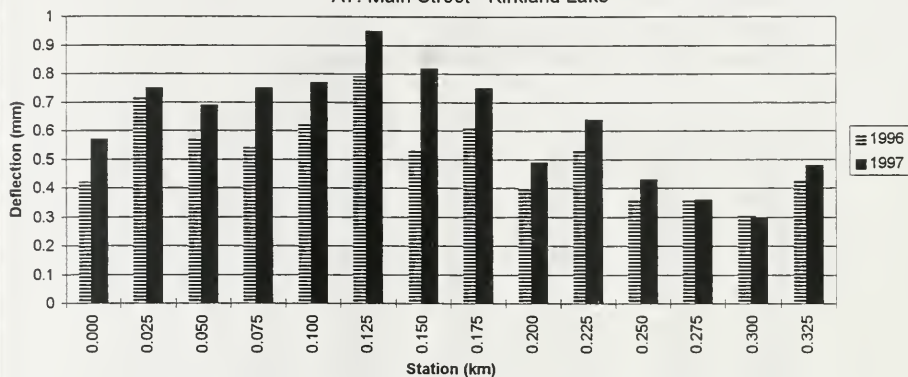
PAVEMENT DEFLECTION ANALYSIS RESULTS

A7. MAIN STREET, KIRKLAND LAKE

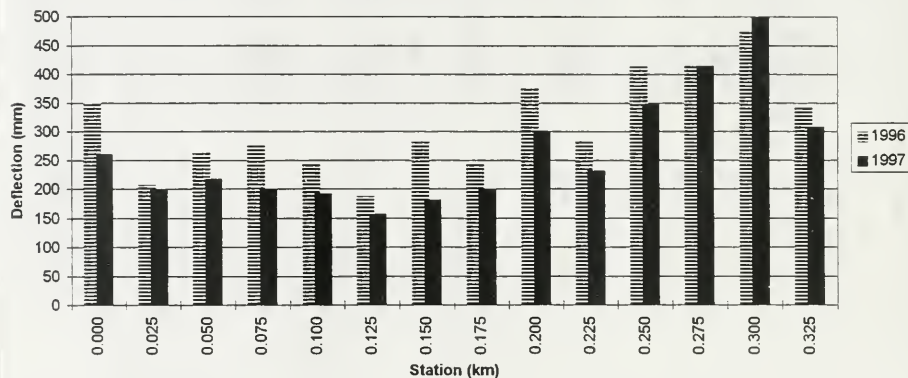
Birch Street south to Power Plant

Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)		Pavement Surface Modulus (MPa)	
		1996	1997	1996	1997
0.000	SBL	0.42	0.57	351	260
0.025	NBL	0.72	0.75	207	199
0.050	SBL	0.57	0.69	263	217
0.075	NBL	0.54	0.75	276	199
0.100	SBL	0.62	0.77	242	192
0.125	NBL	0.79	0.95	187	157
0.150	SBL	0.53	0.82	283	181
0.175	NBL	0.61	0.75	245	199
0.200	SBL	0.40	0.49	376	301
0.225	NBL	0.53	0.64	283	231
0.250	SBL	0.36	0.43	413	348
0.275	NBL	0.36	0.36	415	415
0.300	SBL	0.31	0.30	474	500
0.325	NBL	0.43	0.48	344	308
Mean		0.51	0.63	311	265
Standard Deviation		0.14	0.19	85.5	99.4
Coefficient of Variation		27.6	30.5	27.5	37.5

FWD Deflection
A7. Main Street - Kirkland Lake



FWD Deflection
A7. Main Street - Kirkland Lake



1996
Photograph A7-1a
Station 0+275, low
severity transverse
crack.
[05/14/96, SR]



1997
Photograph A7-1b
Station 0+275,
showing same crack
as above.
[07/07/97, PP]



Photograph A7-1 Town of Kirkland Lake - Main Street at Station 0+275 from south project limit. Condition of low severity transverse crack has not deteriorated appreciably since 1996.



1996

Photograph A7-2

Town of Kirkland Lake - Main Street at Station 0+227. Moderate severity depression in line with natural gas trench. not related to RMA use. [05/14/96, SR]



1997

Photograph A7-3

Town of Kirkland Lake - Main Street at Station 0+170 from south project limit. Note low severity edge cracking in southbound lane. not related to RMA use.

[07/07/97, PP]

A8. Maryborough Township Sideroad 6

Location: Highway 86 to Concession 3, 2.7 km.

Construction Date: November 18-22, 1993

Contractor: Murray Group

CRM: 45 tonnes (9000 tires), 1.41% #10 mesh CRM

Distress Summary:

Distress Type	1996			1997		
	Low	Moderate	High	Low	Moderate	High
Longitudinal (m)	62	16	0	140	16	0
Transverse (m)	16	0	0	16	0	0
Construction Joint (m)	1350	0	0	1350	0	0
Meandering (m)	0	0	0	0	0	0
Alligator (m ²)	0	0	0	0	0	0
Edge (m)	0	0	0	0	0	0
Ravelling (m ²)	13600	0	0	13600	0	0
Patching (m ²)	1	0	0	1	0	0
PCI	86			85		

Comments: In fair condition with coarse aggregate loss over much of the surface, worse in localized areas.

Rubber Modified Asphalt Detailed Pavement Monitoring Sections
A8. Maryborough Township Sideroad 6 from Hwy 86 to Concession 3, 2.71 km

Detailed Pavement Distresses for 1996

Station	Pavement Distress Type														Remarks
	Cracks														
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling		
													(m ²)	(m ²)	
0+450	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Low	Low	SB
0+740						7								0.5	1 Pothole*
0+800															1 Pothole*
1+050	2														
1+370						12									SB
1+400							8								NB
1+420	6.8														
1+530	5														NB
1+650						38									SB
1+790						5									NB
2+705	2														NB
2+710							8								NB
Estimated											1350		13600		
Total, 1996	Transverse		Meandering		Longitudinal		Edge		Alligator		Construction Joint		Ravelling		Patching
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Low	Low	
	16	0	0	0	0	62	16	0	0	0	0	1350	0	13600	

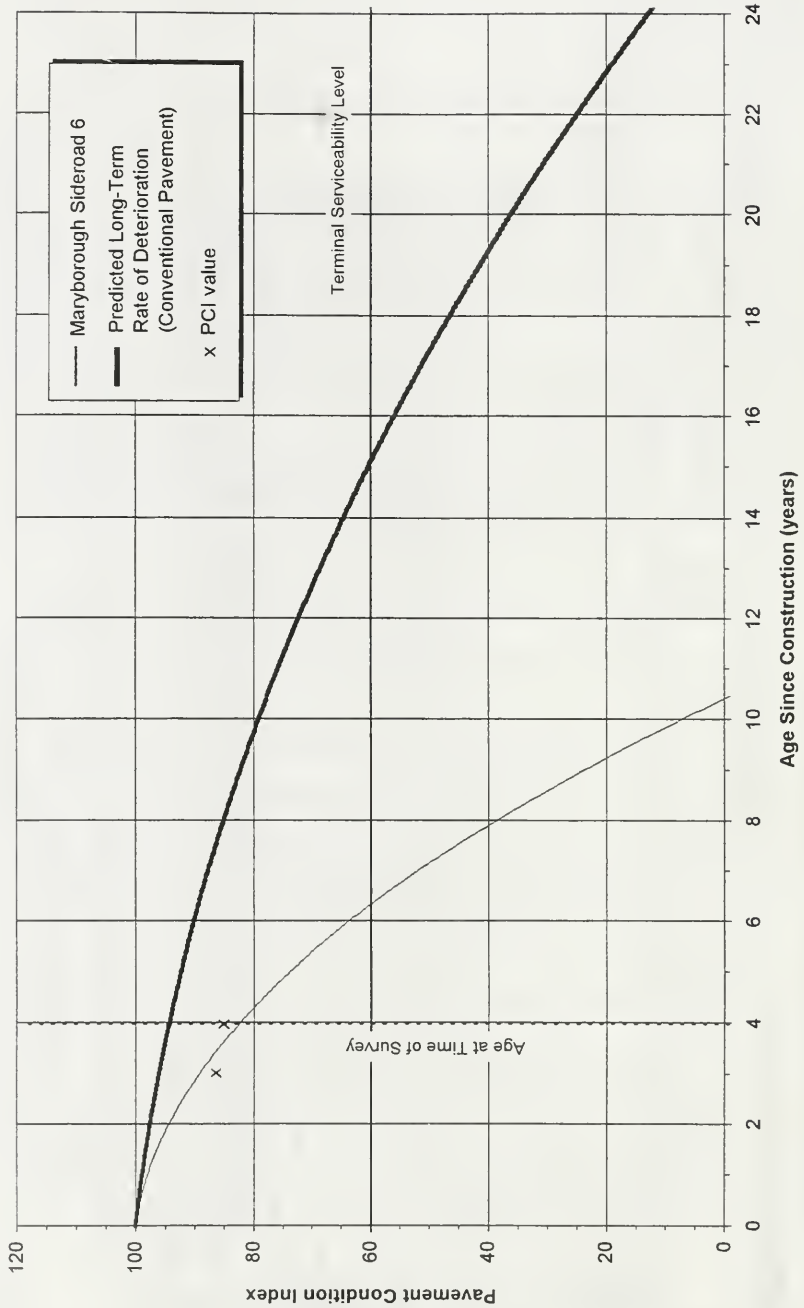
A8. Maryborough Township Sideroad 6 from Hwy 36 to Concession 3, 2.71 km

Detailed Pavement Distresses for 1997

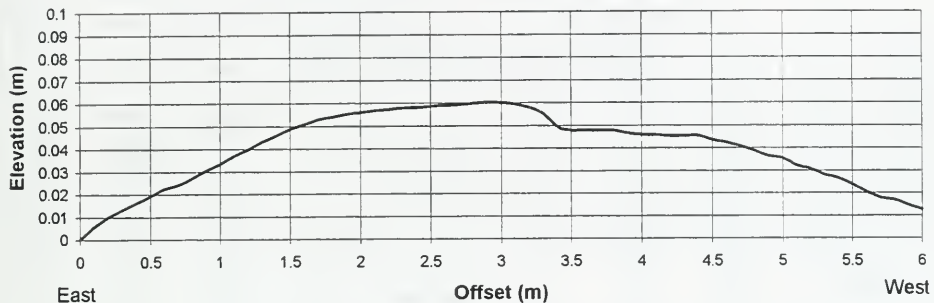
Station	Pavement Distress Type														Remarks		
	Cracks																
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)			Patching (m ²)	
Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Low	Low	Low	
0+450					7											SB	
0+740															0.5	1 Pothole*	
0+800																1 Pothole*	
1+050	2															NB	
1+220					1											SB	
1+370					12											NB	
1+400						8										NB	
1+420	6.8															NB	
1+530	5															SB	
1+570					60											SB	
1+650					38											SB	
1+790					5											NB	
2+110					10											NB	
2+140					7											NB	
2+705	2															NB	
2+710						8										NB	
Estimated											1350			13600			
	Transverse		Meandering		Longitudinal		Edge		Alligator		Construction Joint		Ravelling		Patching		
Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Low	Low	Low	
Total, 1997	16	0	0	0	0	140	16	0	0	0	1350	0	13600	1			

Note: * Potholes have been patched.

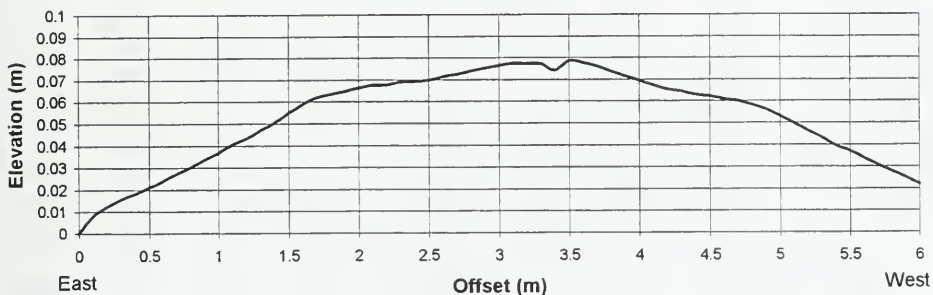
Pavement Life-Cycle Modelling A8. Maryborough Township Sideroad 6



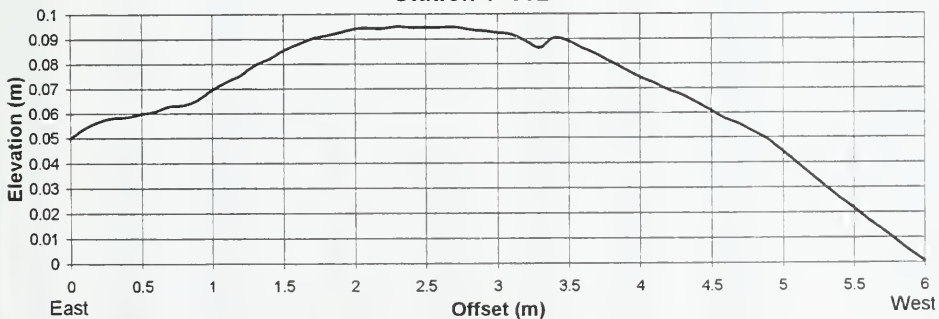
**A8. Maryborough Township Road 6
Station 0+026**



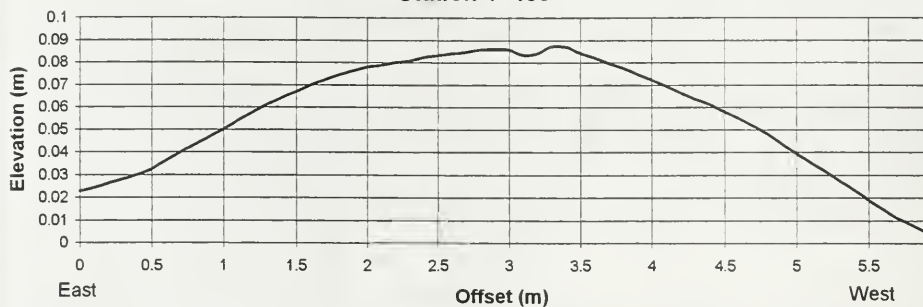
**A8. Maryborough Township Road 6
Station 0+518**



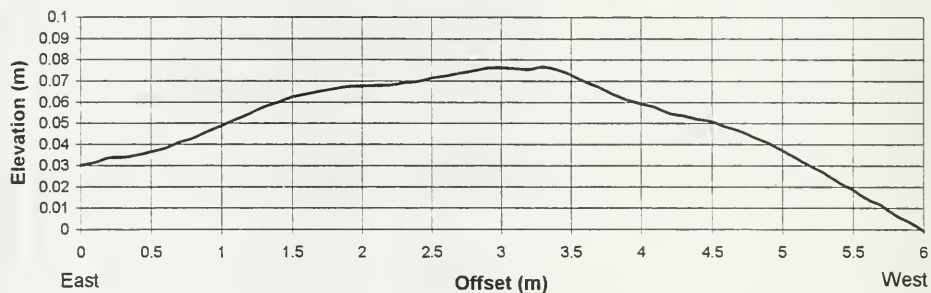
**A8. Maryborough Township Road 6
Station 1+052**



**A8. Maryborough Township Road 6
Station 1+483**



**A8. Maryborough Township Road 6
Station 1+851**



PAVEMENT DEFLECTION ANALYSIS RESULTS

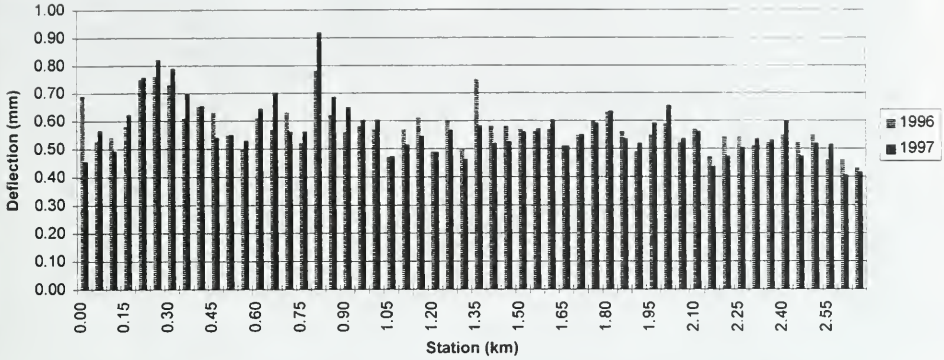
A8. MARYBOROUGH TWP SIDEROAD 6

Hwy 86 to Concession 3

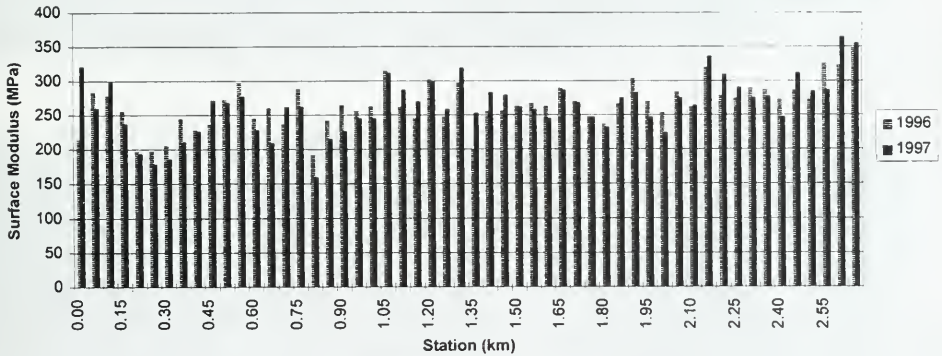
Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
0.00	NBL	0.69	0.88	0.46	215	169	321
0.05	SBL	0.53	1.09	0.57	283	137	260
0.10	NBL	0.54	0.95	0.49	278	157	298
0.15	SBL	0.58	1.20	0.62	255	125	238
0.20	NBL	0.75	1.46	0.76	198	102	194
0.25	SBL	0.76	1.58	0.82	197	94	179
0.30	NBL	0.73	1.52	0.79	205	98	186
0.35	SBL	0.61	1.34	0.70	244	111	211
0.40	NBL	0.65	1.26	0.66	228	119	226
0.45	SBL	0.63	1.04	0.54	236	143	272
0.50	NBL	0.55	1.06	0.55	272	141	268
0.55	SBL	0.50	1.02	0.53	297	146	277
0.60	NBL	0.61	1.24	0.64	245	120	228
0.65	SBL	0.57	1.35	0.70	260	110	209
0.70	NBL	0.63	1.08	0.56	237	138	262
0.75	SBL	0.52	1.08	0.56	288	138	262
0.80	NBL	0.78	1.77	0.92	192	84	160
0.85	SBL	0.62	1.32	0.69	242	113	215
0.90	NBL	0.56	1.25	0.65	265	119	226
0.95	SBL	0.58	1.16	0.60	257	129	245
1.00	NBL	0.57	1.16	0.60	263	129	245
1.05	SBL	0.47	0.91	0.47	314	164	312
1.10	NBL	0.57	0.99	0.51	261	151	287
1.15	SBL	0.61	1.05	0.55	245	142	270
1.20	NBL	0.49	0.94	0.49	302	158	300
1.25	SBL	0.60	1.09	0.57	248	136	258
1.30	NBL	0.50	0.89	0.46	297	168	319
1.35	SBL	0.75	1.12	0.58	200	133	253
1.40	NBL	0.58	1.00	0.52	255	149	283
1.45	SBL	0.58	1.01	0.53	257	147	279
1.50	NBL	0.57	1.08	0.56	263	138	262
1.55	SBL	0.56	1.10	0.57	267	136	258
1.60	NBL	0.57	1.16	0.60	263	129	245
1.65	SBL	0.51	0.98	0.51	290	151	287
1.70	NBL	0.55	1.06	0.55	270	141	268
1.75	SBL	0.60	1.14	0.59	247	130	247
1.80	NBL	0.63	1.22	0.63	237	122	232
1.85	SBL	0.56	1.03	0.54	266	145	276
1.90	NBL	0.49	1.00	0.52	303	149	283
1.95	SBL	0.55	1.14	0.59	271	130	247
2.00	NBL	0.59	1.26	0.66	254	118	224
2.05	SBL	0.52	1.03	0.54	284	145	276
2.10	NBL	0.57	1.08	0.56	261	139	264

Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
2.15	SBL	0.47	0.84	0.44	319	177	336
2.20	NBL	0.54	0.91	0.47	278	163	310
2.25	SBL	0.54	0.97	0.50	274	153	291
2.30	NBL	0.51	1.03	0.54	290	145	276
2.35	SBL	0.52	1.02	0.53	287	146	277
2.40	NBL	0.55	1.15	0.60	272	130	247
2.45	SBL	0.52	0.91	0.47	286	164	312
2.50	NBL	0.55	1.00	0.52	272	150	285
2.55	SBL	0.46	0.99	0.51	326	151	287
2.60	NBL	0.46	0.78	0.41	324	192	365
2.65	SBL	0.43	0.80	0.42	349	187	355
Mean		0.57	1.10	0.57	265	139	264
Standard Deviation		0.08	0.19	0.10	33.6	21.8	41.4
Coefficient of Variation		13.6	17.3	17.3	12.7	15.7	15.7

FWD Deflection
A8. Maryborough Twp SR 6



Surface Modulus
A8. Maryborough Twp SR 6



1996
Photograph A8-1a
Station 0+060.
looking north at
ravelled area in
southbound lane.
[07/08 '96. SR]



1997
Photograph A8-1b
Station 0+060.
looking south at
same area as above.
[05/14/97. PP]



Photograph A8-1 Maryborough Township - Sideroad 6 at Station 0+060 from south project limit.
Note very slight increase in amount of low severity ravelling.

1996



Photograph A8-2

Maryborough Township - Sideroad 6 at Station 1+400. Low severity transverse and medium severity longitudinal cracks. [07/08/96, SR]

1997



Photograph A8-3

Maryborough Township - Sideroad 6 at Station 0+060. Close-up of localized area of low severity ravelling. [05/14/97, PP]

A9-a. Northumberland County Road 9

Location: approx. 1 km east of C.R. 18, 2.7 km.

Construction Date: October 29-November 8, 1993

Distress Summary:

Distress Type	Year					
	1996			1997		
	Low	Moderate	High	Low	Moderate	High
Longitudinal (m)	94	0	0	105	0	0
Transverse (m)	236	41	0	242	41	0
Construction Joint (m)	1073	0	0	1073	0	0
Meandering (m)	0	5	0	0	5	0
Alligator (m ²)	12	0	0	27	0	0
Edge (m)	70	0	0	70	0	0
Ravelling (m ²)	7	0	0	8	0	0
Patching (m ²)	116	0	0	116	0	0
Potholes	0	0	0	0	0	0
PCI		93			92	

Rubber Modified Asphalt Detailed Pavement Monitoring Sections
A9-a. Northumberland County Road 9 from 1 km east of CR 18 to CR15
Detailed Pavement Distresses for 1996

Station	Pavement Distress Type															Remarks	
	Cracks																
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)		Patching (m ²)		
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low			Low
0+000			7														Joint Crack Linton Road
0+017																	
0+127																	Trail Road Joint Crack Joint Crack
0+150	1				2												
0+170																1	
0+180							10										
0+197	3																
0+200	3																
0+205	2																
0+250																	
0+253	3											50					
0+310												10					
0+335												15					
0+355	2																
0+385																	
0+390	2																
0+430	3																
0+500	4																
0+545	4																
0+600	2																
0+650																	
0+660					5											116	
0+700	3																
0+750	2																
0+765																	
0+800	2														3		
0+845																	
0+865																	
0+900	7	6.8															
0+955																	
1+030						5											
1+040							10										
1+075						4											

Joint Crack
Linton Road

Trail Road
Joint Crack
Joint Crack

A9-a. Northumberland County Road 9 from 1 km east of CR 18 to CR15
Detailed Pavement Distresses for 1996

Station	Pavement Distress Type														Remarks
	Cracks														
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling Patching		
													(m ²)		
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	
1+090															
1+120	3						30								
1+130									2						
1+170	4			2											
1+177	3	7									98				
1+190	3	7													
1+215	3			2											
1+230	2			3											
1+235				4											
1+300											30				
1+320				6											
1+425											50				
1+450				8											
1+500										10	70				
1+530				8											
1+600											30				
1+650	2														
1+670															
1+720											70				Sully Road
1+730	3														
1+740	7														
1+765	3														
1+860	6			3											Joint Crack
1+915	4			1											
1+920											30				
1+975	3												1		
1+985	2														
2+012															
2+070	3										8				
2+075	3										20				
2+120	3														
2+170	2														
2+175	3														
2+180	2														

A9-a. Northumberland County Road 9 from 1 km east of CR 18 to CR15
Detailed Pavement Distresses for 1996

Station	Pavement Distress Type														Remarks
	Cracks														
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling Patching (m ²)		
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	
2+190	4														
2+200	4				2										
2+222											13				
2+235	7														
2+290											20				
2+330													2		
2+340											10				
2+370	7														
2+410											20				
2+420		6.8			3										
2+450	5														
2+460	7														
2+475	5										25				
2+485	7														
2+490						20									
2+515	3														
2+530	3														
2+535	5														
2+555	2														
2+565		6.8													
2+605	2														
2+625	7				2										
2+630	7				15										
2+660	3														
2+675	7														
2+680					6										
2+690	7														
2+700	7				8										
2+702	7				10										
2+728	7														
	Transverse		Meandering		Longitudinal		Edge		Alligator		Construction Joint		Ravelling Patching		Joint Crack(End)
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	
Total, 1996	228	41	0	0	5	94	0	70	0	12	0	1073	0	7	116

Rubber Modified Asphalt Detailed Pavement Monitoring Sections
A9-a. Northumberland County Road 9 from 1 km east of CR 18 to CR15

Detailed Pavement Distresses for 1997

Station	Pavement Distress Type															Remarks	
	Cracks																
	Transverse (m)			Meandering (m)			Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)		Patching (m ²)
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate				
0+000			7										117				Joint Crack
0+017																	Linton Road
0+127														27			
0+150	1				2												
0+170															1		
0+180									10								
0+197	3																
0+200	3																
0+205	2																
0+250														50			
0+253	3																
0+300	4																
0+310														10			
0+335														15			
0+355	5																
0+385														275			
0+390	5																
0+430	3																
0+485	4																
0+500	4																
0+545	4																
0+600	2																
0+650				5												116	
0+660																	
0+700	3																
0+750	2																
0+765															4		
0+800	2																
0+845																	Trail Road
0+865		6.8												40			Joint Crack
0+900	7																Joint Crack
0+955														45			Joint Crack
1+030					5												
1+040										10							

Trail Road
Joint Crack
Joint Crack

Joint Crack
Linton Road

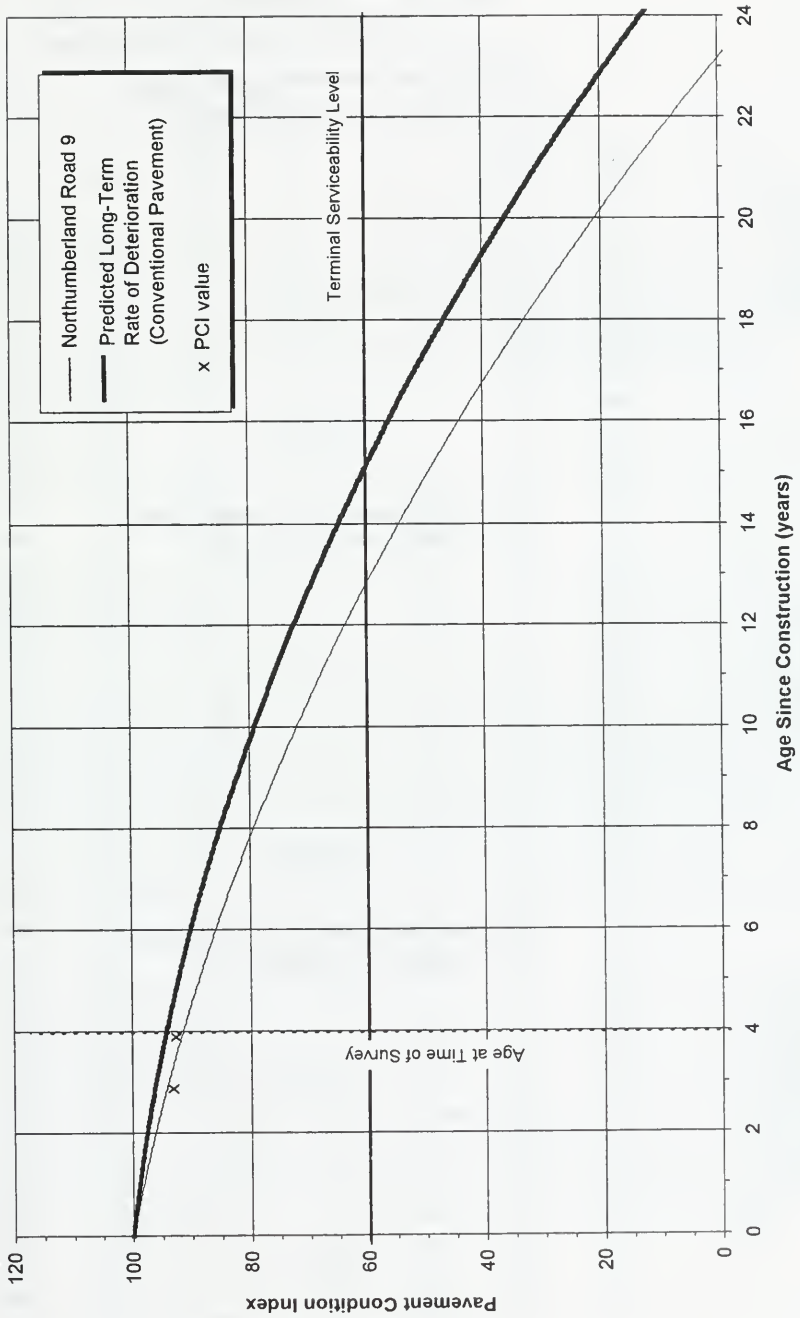
A9-a Northumberland County Road 9 from 1 km east of CR 18 to CR 15

Detailed Pavement Distresses for 1997

[illegible]

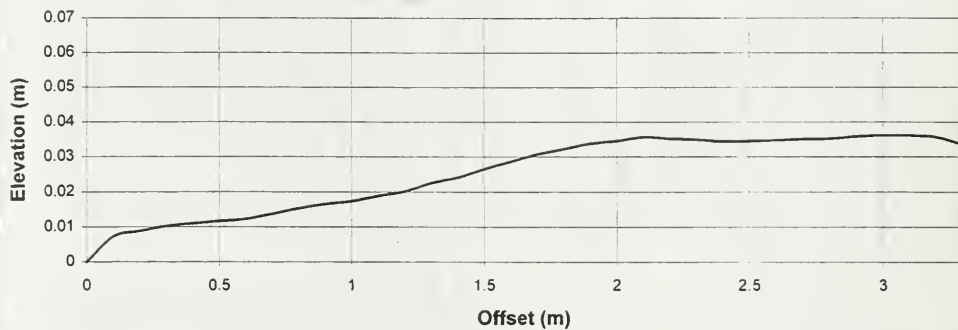
[illegible]

Pavement Life-Cycle Modelling
A9-a. Northumberland County Road 9

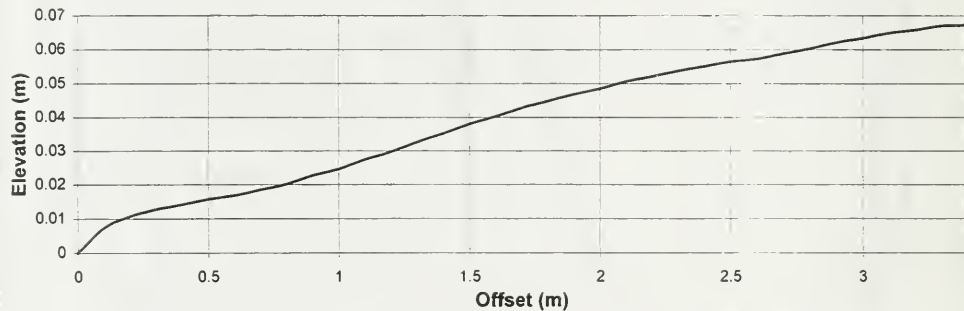


Pavement Profile Measurements

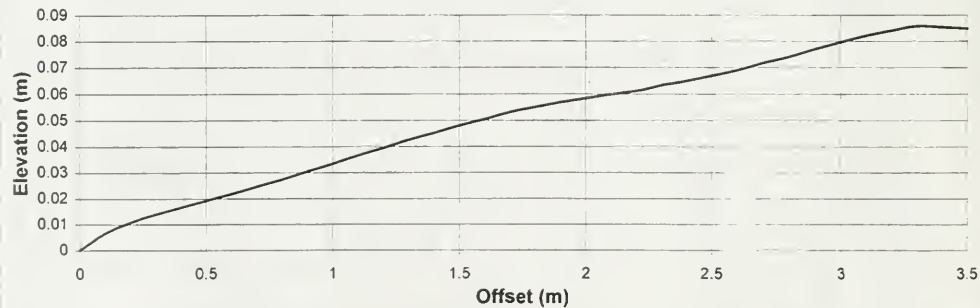
**A9-a. Northumberland County Road 9
Station 0+205 EB Lane**



**A9-a. Northumberland County Road 9
Station 1+600 EB Lane**



**A9-a. Northumberland County Road 9
Station 0+800 WB Lane**

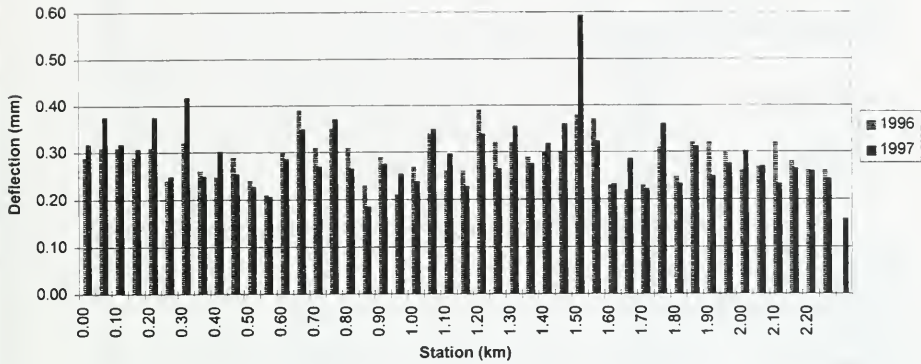


PAVEMENT DEFLECTION ANALYSIS RESULTS
 A9-a. NORTHUMBERLAND COUNTY ROAD 9
 1 km East of County Road 18 to County Road 15

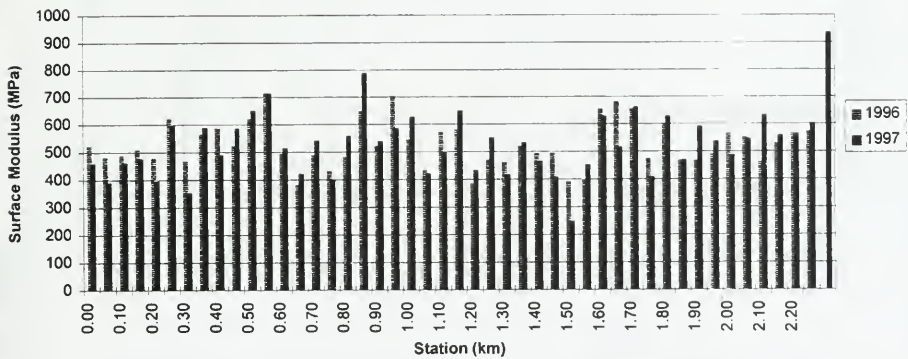
Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
0.00	EBL	0.29	0.6	0.32	523	246	461
0.05	WBL	0.31	0.71	0.38	483	209	391
0.10	EBL	0.31	0.6	0.32	487	247	463
0.15	WBL	0.29	0.58	0.31	511	255	478
0.20	EBL	0.31	0.71	0.38	479	211	395
0.25	WBL	0.24	0.47	0.25	622	319	597
0.30	EBL	0.32	0.79	0.42	467	189	354
0.35	WBL	0.26	0.47	0.25	567	315	590
0.40	EBL	0.25	0.57	0.30	587	262	491
0.45	WBL	0.29	0.48	0.25	522	313	586
0.50	EBL	0.24	0.43	0.23	624	348	652
0.55	WBL	0.21	0.39	0.21	715	382	715
0.60	EBL	0.30	0.54	0.29	493	275	515
0.65	WBL	0.39	0.66	0.35	381	225	421
0.70	EBL	0.31	0.51	0.27	488	290	543
0.75	WBL	0.35	0.7	0.37	430	214	401
0.80	EBL	0.31	0.5	0.27	483	298	558
0.85	WBL	0.23	0.35	0.19	647	421	788
0.90	EBL	0.29	0.52	0.28	521	288	539
0.95	WBL	0.21	0.48	0.25	706	313	586
1.00	EBL	0.27	0.45	0.24	546	335	627
1.05	WBL	0.34	0.66	0.35	433	225	421
1.10	EBL	0.26	0.56	0.30	575	266	498
1.15	WBL	0.26	0.43	0.23	583	347	650
1.20	EBL	0.39	0.64	0.34	383	231	433
1.25	WBL	0.32	0.5	0.27	471	295	552
1.30	EBL	0.32	0.67	0.36	463	223	418
1.35	WBL	0.29	0.52	0.28	520	285	534
1.40	EBL	0.30	0.6	0.32	493	249	466
1.45	WBL	0.30	0.68	0.36	494	218	408
1.50	EBL	0.38	1.12	0.59	389	133	249
1.55	WBL	0.37	0.61	0.32	400	242	453
1.60	EBL	0.23	0.44	0.23	654	336	629
1.65	WBL	0.22	0.54	0.29	681	276	517
1.70	EBL	0.23	0.42	0.22	658	354	663
1.75	WBL	0.31	0.68	0.36	473	218	408
1.80	EBL	0.25	0.44	0.23	597	336	629
1.85	WBL	0.32	0.59	0.31	469	251	470
1.90	EBL	0.32	0.47	0.25	468	316	592
1.95	WBL	0.30	0.52	0.28	489	287	537
2.00	EBL	0.26	0.57	0.30	566	260	487
2.05	WBL	0.27	0.51	0.27	551	292	547
2.10	EBL	0.32	0.44	0.23	460	338	633

Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
2.15	WBL	0.28	0.5	0.27	529	298	558
2.20	EBL	0.26	0.49	0.26	568	302	566
2.25	WBL	0.26	0.46	0.24	574	322	603
2.30	EBL	0.19	0.3	0.16	783	500	936
Mean		0.29	0.55	0.29	532	284	532
Standard Deviation		0.05	0.13	0.07	90.7	63.5	118.9
Coefficient of Variation		16.3	24.3	24.3	17.1	22.3	22.3

FWD Deflection
A9. Northumberland County Road 9



Surface Modulus
A9. Northumberland County Road 9



A9-b. Northumberland County Road 18

Location: C.R. 74 north, 1.7 km

Construction Date: November 10-11, 1993

Distress Summary:

Distress Type	Year					
	1996			1997		
	Low	Moderate	High	Low	Moderate	High
Longitudinal (m)	432	0	0	477	0	0
Transverse (m)	641	84	0	671	84	0
Construction Joint (m)	690	0	0	690	0	0
Meandering (m)	34	65	0	42	65	0
Alligator (m ²)	5	0	0	5	0	0
Edge (m)	252	0	0	252	0	0
Ravelling (m ²)	2	0	0	2	0	0
Patching (m ²)	0	0	0	0	0	0
Potholes	0	0	0	0	0	0
PCI	84			84		

Data for both A9-a and A9-b:

Contractor: Wimpey

Mix: 5.1% Ecoflex - 10% rubber and 85/100 A.C. produced by Bitumar Incorporated

Comments: Pavement in fair to good condition with regularly spaced cracking.

Rubber Modified Asphalt Detailed Pavement Monitoring Sections
A9-b. Northumberland County Road 18 from CR74 to 1.74 km north

Detailed Pavement Distresses for 1996*

Detailed Pavement Distresses for 1996															Remarks	
Station	Pavement Distress Type															
	Cracks															
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)			Patching (m ²)
Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Low
0+000 to 0+100	32	14		4		8		19				73			2	
0+100 to 0+200	40	14			13		14					85				
0+200 to 0+300	80				7		6					96				
0+300 to 0+400	63				2		3					100				
0+400 to 0+500	51			4		9						100				
0+500 to 0+600	35	13		16		61						27				
0+600 to 0+700	26	7		2		27				2		64				
0+700 to 0+800	36	7		2		13		3				8				
0+800 to 0+805	58	7		6		44		11				19				
0+800 to 1+000	41	14				57						16				
1+000 to 1+100	27					27						25				
1+100 to 1+200	20					48					3	31				
1+200 to 1+300	18					12		6								
1+300 to 1+400	22							36				33				
1+400 to 1+500	21					32		85								
1+500 to 1+600	40					25		4								
1+600 to 1+700	25					32										
1+700 to 1+740	6	8				15		20				13				
Total 1996	Transverse		Meandering		Longitudinal		Edge		Alligator		Construction Joint		Ravelling		Patching	
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low
	641	84	0	34	65	432	0	252	0	5	0	690	0	2	0	0

Note: *Refer to Pavement Inspection Forms for distress locations.

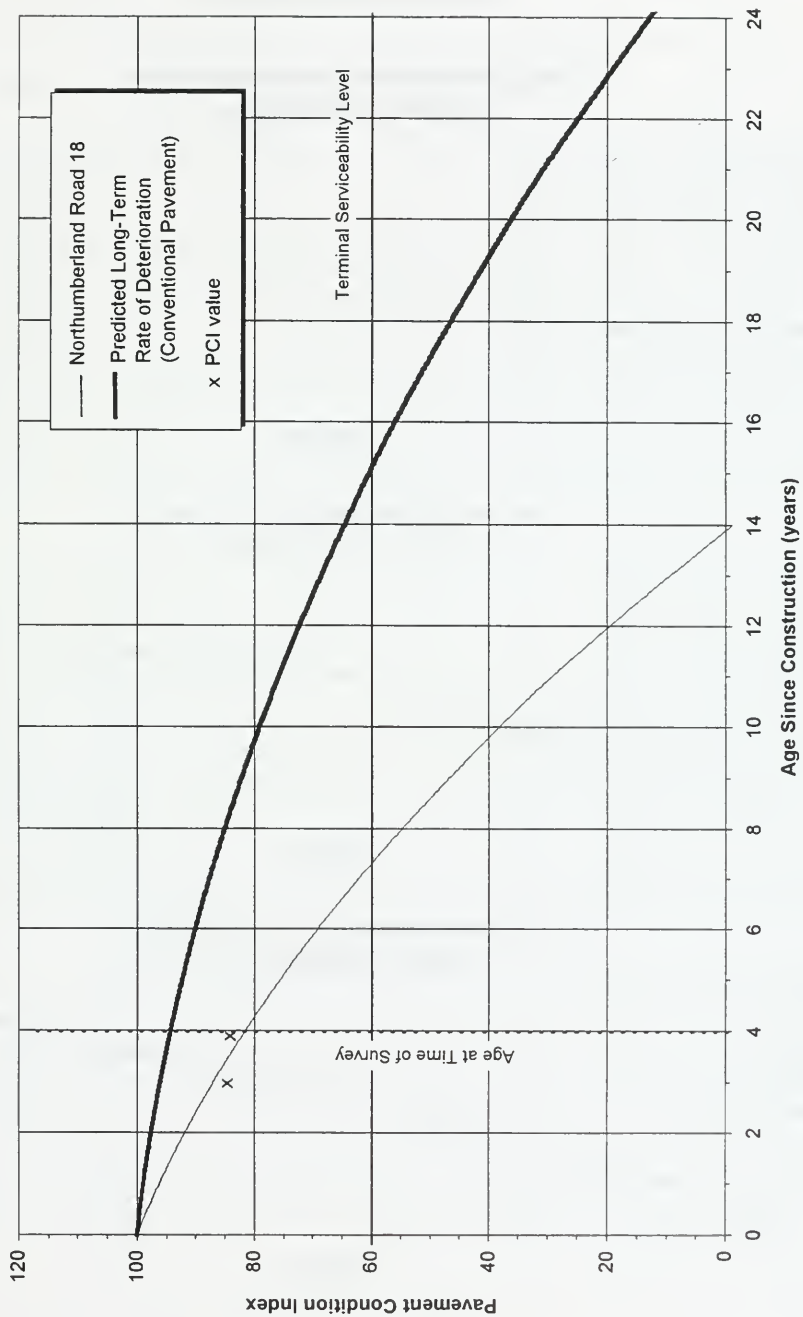
A9-b Northumberland County Road 18 from CR74 to 1.74 km north

Detailed Pavement Distresses for 1997*

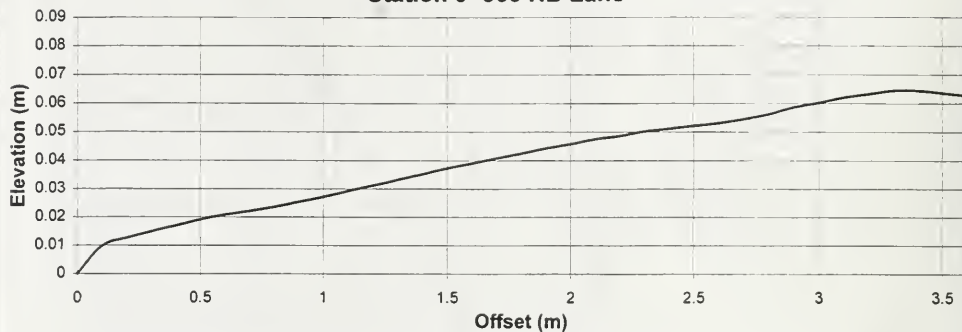
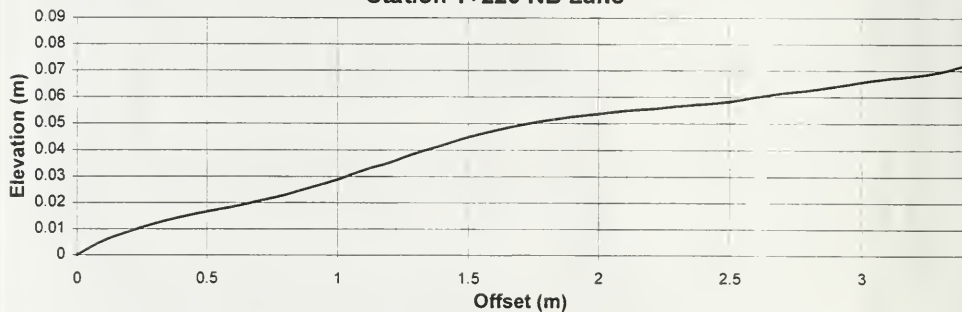
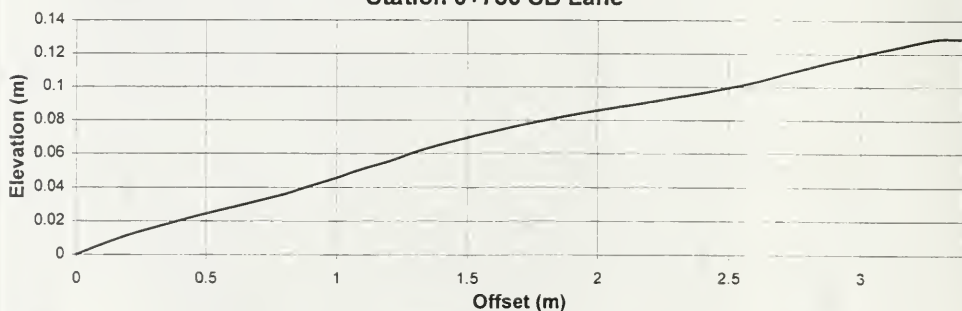
Station	Pavement Distress Type															Remarks
	Cracks															
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)	Patching (m ²)		
Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Low		
0+000 to 1+740	32	14		4		8		19				73			2	
			14			13		14					85			
	83					12		6				96				
	64					11		3				100				
	59			4		28						100				
	35	13		16		61						27				
	26	7		2		27				2		64				
	36	7		2	29	13		3				8				
	58	7		6	36	44		11				19				
	41	14				64						16				
	31					32						25				
	25			8		48						31				
	18					12		6								
	22					0		36				33				
	23					32		85								
43					25		4									
27					32		45				13					
8		8				15		20								
Total, 1997	Low	Transverse	High	Low	Moderate	Low	Longitudinal	Low	Moderate	Low	Moderate	Low	Moderate	Low	Ravelling	Patching
	671	84	0	42	65	477	0	252	0	5	0	690	0	2	0	0

Note: *Refer to Pavement Inspection Forms for distress locations.

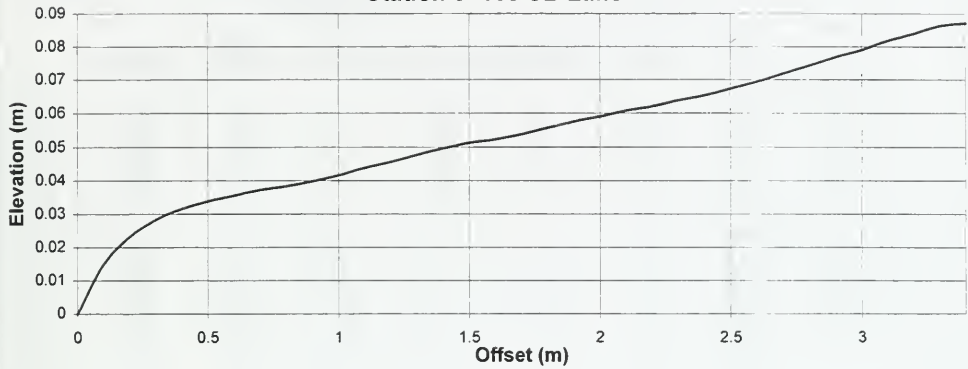
Pavement Life-Cycle Modeling A9-b. Northumberland County Road 18



Pavement Profile Measurements

**A9-b. Northumberland County Road 18
Station 0+365 NB Lane****A9-b. Northumberland County Road 18
Station 1+220 NB Lane****A9-b. Northumberland County Road 18
Station 0+750 SB Lane**

Pavement Profile Measurements

**A9-b. Northumberland County Road 18
Station 0+165 SB Lane**

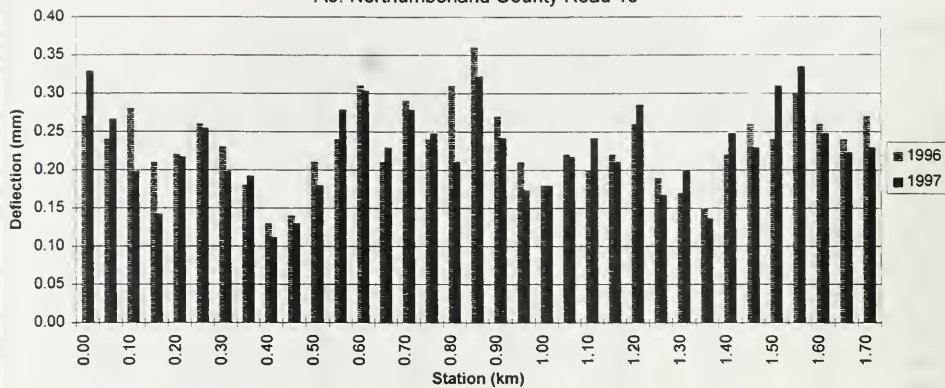
British Pendulum Testing
Northumberland County

Station	Lane	British Pendulum Number					
		Dry			Wet		
		Wheel 1	Midpoint	Wheel 2	Wheel 1	Midpoint	Wheel 2
County Road 9							
0+365	NB	71	70	70	48	54	47
1+220	NB	66	69	68	51	54	48
0+750	SB	69	70	70	48	51	47
0+165	SB	71	73	70	50	52	50
County Road 18							
0+205	EB	78	80	77	55	65	56
1+600	EB	80	81	80	54	64	53
0+800	WB	78	82	78	55	65	54

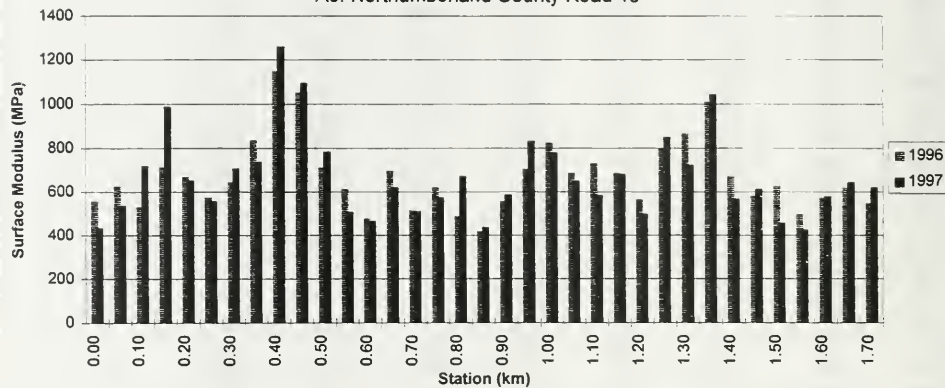
PAVEMENT DEFLECTION ANALYSIS RESULTS
A9-b. NORTHUMBERLAND COUNTY ROAD 18
County Road 74 to Majestic Hills

Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
0.00	NBL	0.27	0.53	0.33	559	283	435
0.05	SBL	0.24	0.43	0.27	625	350	538
0.10	NBL	0.28	0.32	0.20	532	468	720
0.15	SBL	0.21	0.23	0.14	714	643	989
0.20	NBL	0.22	0.35	0.22	668	425	654
0.25	SBL	0.26	0.41	0.25	575	363	558
0.30	NBL	0.23	0.32	0.20	646	460	708
0.35	SBL	0.18	0.31	0.19	834	480	738
0.40	NBL	0.13	0.18	0.11	1147	819	1260
0.45	SBL	0.14	0.21	0.13	1056	712	1095
0.50	NBL	0.21	0.29	0.18	710	510	785
0.55	SBL	0.24	0.45	0.28	613	330	508
0.60	NBL	0.31	0.49	0.30	477	303	466
0.65	SBL	0.21	0.37	0.23	696	404	622
0.70	NBL	0.29	0.45	0.28	514	332	511
0.75	SBL	0.24	0.40	0.25	622	373	574
0.80	NBL	0.31	0.34	0.21	487	437	672
0.85	SBL	0.36	0.52	0.32	419	285	438
0.90	NBL	0.27	0.39	0.24	557	382	588
0.95	SBL	0.21	0.28	0.17	707	541	832
1.00	NBL	0.18	0.29	0.18	823	507	780
1.05	SBL	0.22	0.35	0.22	688	423	651
1.10	NBL	0.20	0.39	0.24	733	381	586
1.15	SBL	0.22	0.34	0.21	685	443	682
1.20	NBL	0.26	0.46	0.29	567	324	498
1.25	SBL	0.19	0.27	0.17	804	553	851
1.30	NBL	0.17	0.32	0.20	866	470	723
1.35	SBL	0.15	0.22	0.14	1010	679	1045
1.40	NBL	0.22	0.40	0.25	671	370	569
1.45	SBL	0.26	0.37	0.23	580	399	614
1.50	NBL	0.24	0.50	0.31	629	297	457
1.55	SBL	0.30	0.54	0.33	499	277	426
1.60	NBL	0.26	0.40	0.25	571	377	580
1.65	SBL	0.24	0.36	0.22	617	419	645
1.70	NBL	0.27	0.37	0.23	546	404	622
Mean		0.23	0.37	0.23	670	435	669
Standard Deviation		0.05	0.09	0.06	163	126	194
Coefficient of Variation		21.6	25.0	25.0	24.4	29.0	29.0

FWD Deflection
A9. Northumberland County Road 18



Surface Modulus
A9. Northumberland County Road 18



1996
Photograph A9-1a
Station 0+670.
patching over both
lanes. [07/12/96, SR]



1997
Photograph A9-1b
Station 0+670,
looking west.
[07/18/97, PP]



Photograph A9-1 Northumberland County Road 9 (1993 section. Wet Process) at Station 0+670 from west project limit. Note low severity patch and increase in severity of construction joint cracking.

1996



Photograph A9-2 Northumberland County Road 9 in westbound lane at Station 1+600.
Localized low severity meandering and alligator cracking. [07/12/96. SR]

1997



Photograph A9-3 Northumberland County Road 9 at Station 1+620. Low severity transverse
and construction joint cracking. [07/18/97. PP]



1996
Photograph A9-4a
Station 0+800.
southbound lane.
[07/12/96, SR]



1997
Photograph A9-4b
Station 0+800.
[07/18/97, PP]

Photograph A9-4 Northumberland County Road 18 (1993 section, Wet Process) at Station 0+800 from south project limit, showing slight increase in length of medium severity transverse and mid-lane meandering cracks.

1996
Photograph A9-5a
Station 1+740, at
north project limit.
[07/12/96, SR]



1997
Photograph A9-5b
Station 1+740, at
joint with existing
pavement.
[07/18/97, PP]



Photograph A9-5 Northumberland County Road 18 at Station 1+740. Note patching at joint with existing pavement and additional slight ravelling near joint.

A10-a. Haldimand-Norfolk Regional Road 55

Location: Regional Road 9 to Regional Road 20, 4.8 km.

Construction Date: October 23-26, 1990

Distress Summary:

Distress Type	Year					
	1996			1997		
	Low	Moderate	High	Low	Moderate	High
Longitudinal (m)	394	30	0	496	30	0
Transverse (m)	123	62	4	135	62	4
Construction Joint (m)	385	74	0	385	74	0
Meandering (m)	0	0	0	8	0	0
Alligator (m ²)	13	0	0	35	0	0
Edge (m)	0	0	0	0	0	0
Ravelling (m ²)	3	0	0	3	0	0
Patching (m ²)	160	0	0	160	0	0
Potholes	4	0	0	4	0	0
PCI	75			74		

Comments: The areas of more severe cracking and ravelling have been spray-patched.
Generally in fair condition.

Rubber Modified Asphalt Detailed Pavement Monitoring Sections
A10a. Haldimand Norfolk Regional Road 55

Detailed Pavement Distresses for 1996*

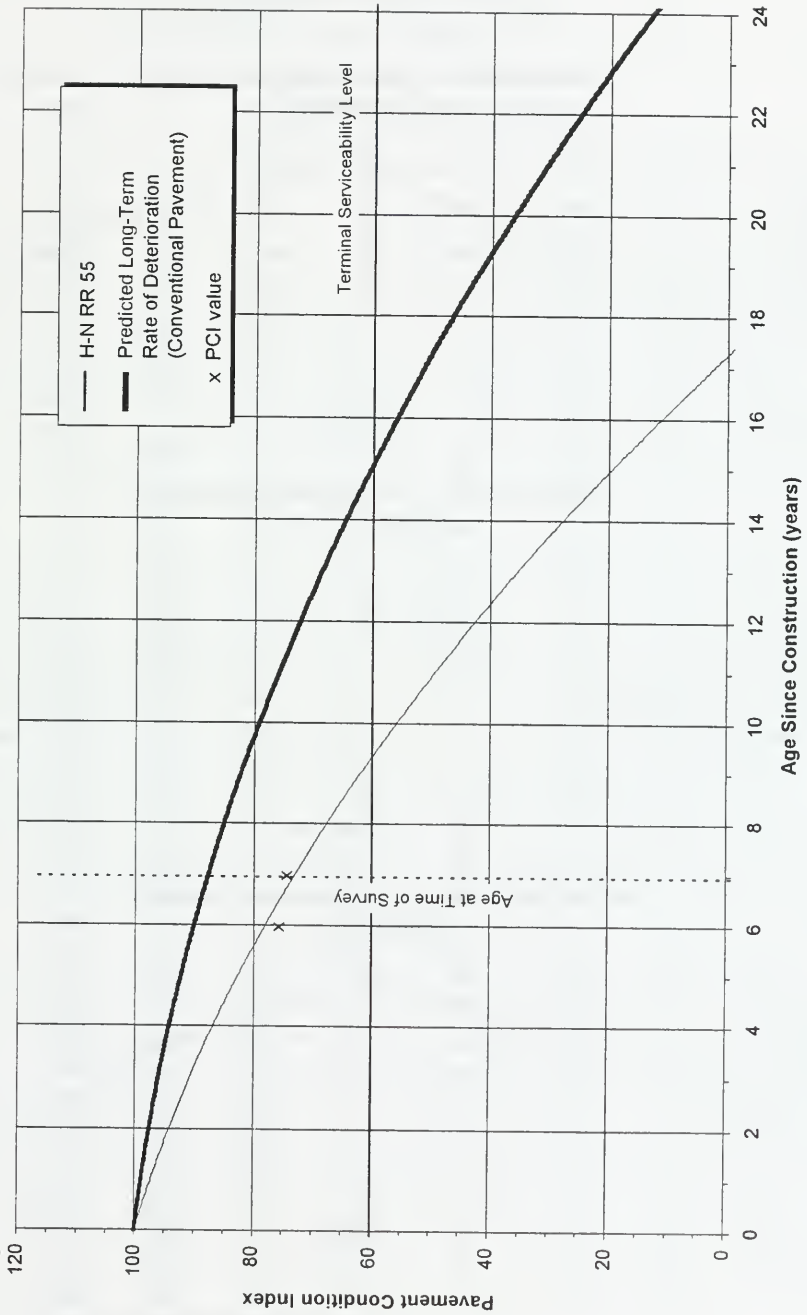
Station	Pavement Distress Type												Remarks			
	Cracks															
	Transverse (m)			Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Patching (m ²)		
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate					
0+400 to 0+500	21	37			44						76	38	1 Pothole			
1+500 to 1+600	37	8			64						94	3	1 Pothole			
2+000 to 2+100	25	13			102			13			100		1 Pothole			
3+600 to 3+700	30	3.5	4		73						100					
4+500 to 4+600	10				111	30					15	74	1 Pothole			
	Transverse			Meandering		Longitudinal		Edge		Alligator		Construction Joint	Patching			
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Low			
Total, 1996	123	62	4	0	0	394	30	0	0	13	0	385	74	3	160	4 Potholes

Detailed Pavement Distresses for 1997*

Station	Pavement Distress Type												Remarks		
	Cracks														
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)	Patching (m ²)			
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low		Low	
0+400 to 0+500	25	37			47			2			76	38	1 Pothole		
1+500 to 1+600	39	8			64			20			94	70	1 Pothole		
2+000 to 2+100	25	13			184			13			100	52	1 Pothole		
3+600 to 3+700	36	3.5	4		82						100				
4+500 to 4+600	10			8	119	30					15	74	1 Pothole		
	Transverse		Meandering		Longitudinal		Edge		Alligator		Construction Joint	Patching			
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Low		
Total, 1997	135	62	4	8	0	496	30	0	35	0	385	74	3	160	4 Potholes

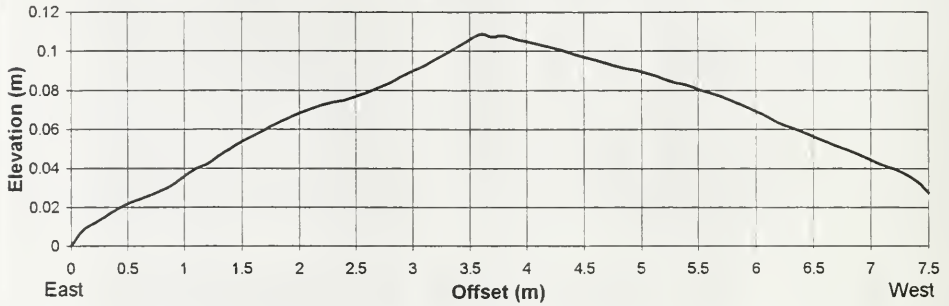
Note: * Refer to Pavement Inspection Forms for distress locations.

Pavement Life-Cycle Modelling A10-a. Haldimand - Norfolk Regional Road 55

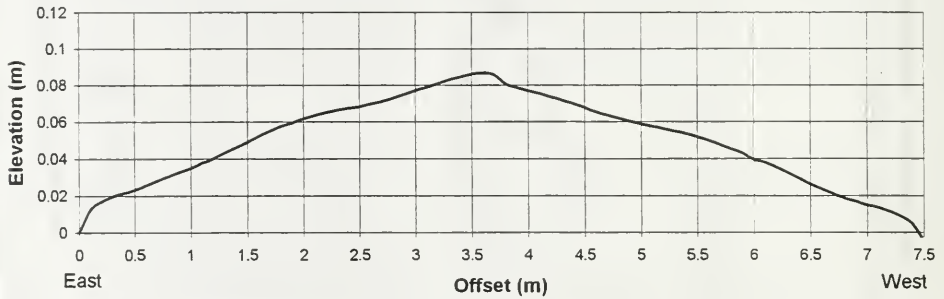


Pavement Profile Measurements

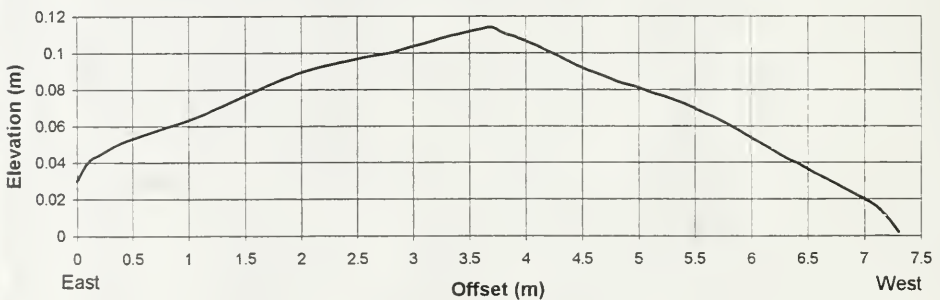
A10-a. Haldimand-Norfolk Regional Road 55
Station 0+410



A10-a. Haldimand-Norfolk Regional Road 55
Station 1+741



A10-a. Haldimand-Norfolk Regional Road 55
Station 2+826



PAVEMENT DEFLECTION ANALYSIS RESULTS
A10-a. HALDIMAND-NORFOLK REGIONAL ROAD 55
Regional Road 9 to Regional Road 20

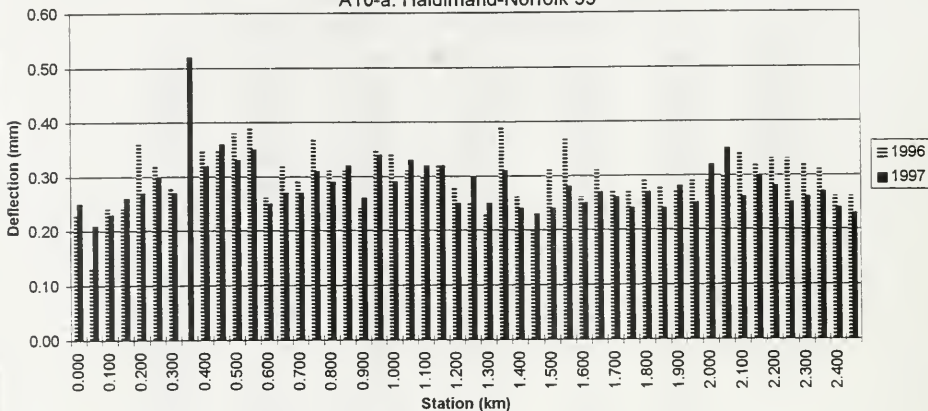
Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)		Pavement Surface Modulus (MPa)	
		1996	1997	1996	1997
0.000	NBL	0.23	0.25	635	586
0.049	SBL	0.13	0.21	1147	715
0.100	NBL	0.24	0.23	628	660
0.150	SBL	0.24	0.26	612	572
0.200	NBL	0.36	0.27	414	542
0.250	SBL	0.32	0.30	470	498
0.300	NBL	0.28	0.27	527	558
0.354	SBL	0.77*	0.52	194	288
0.400	NBL	0.35	0.32	429	470
0.450	SBL	0.35	0.36	427	410
0.500	NBL	0.38	0.33	396	452
0.550	SBL	0.39	0.35	379	420
0.600	NBL	0.26	0.25	569	597
0.650	SBL	0.32	0.27	462	557
0.700	NBL	0.29	0.27	521	562
0.750	SBL	0.37	0.31	408	476
0.800	NBL	0.31	0.29	485	508
0.850	SBL	0.31	0.32	479	468
0.900	NBL	0.24	0.26	625	582
0.950	SBL	0.35	0.34	428	444
1.000	NBL	0.34	0.29	441	519
1.050	SBL	0.31	0.33	481	451
1.100	NBL	0.30	0.32	497	460
1.150	SBL	0.32	0.32	465	468
1.200	NBL	0.28	0.25	524	600
1.250	SBL	0.25	0.30	584	497
1.300	NBL	0.23	0.25	660	587
1.350	SBL	0.39	0.31	383	473
1.400	NBL	0.26	0.24	584	621
1.450	SBL	0.20	0.23	752	641
1.500	NBL	0.31	0.24	484	619
1.550	SBL	0.37	0.28	405	539
1.600	NBL	0.26	0.25	584	589
1.650	SBL	0.31	0.27	475	552
1.700	NBL	0.27	0.26	545	565
1.750	SBL	0.27	0.24	559	612
1.800	NBL	0.29	0.27	505	558
1.850	SBL	0.28	0.24	530	626
1.900	NBL	0.27	0.28	561	535
1.950	SBL	0.29	0.25	506	595
2.000	NBL	0.29	0.32	513	472
2.050	SBL	0.30	0.35	501	421
2.100	NBL	0.34	0.26	441	584
2.150	SBL	0.32	0.30	471	497
2.200	NBL	0.33	0.28	458	537

Note: * Not included in statistical analysis.

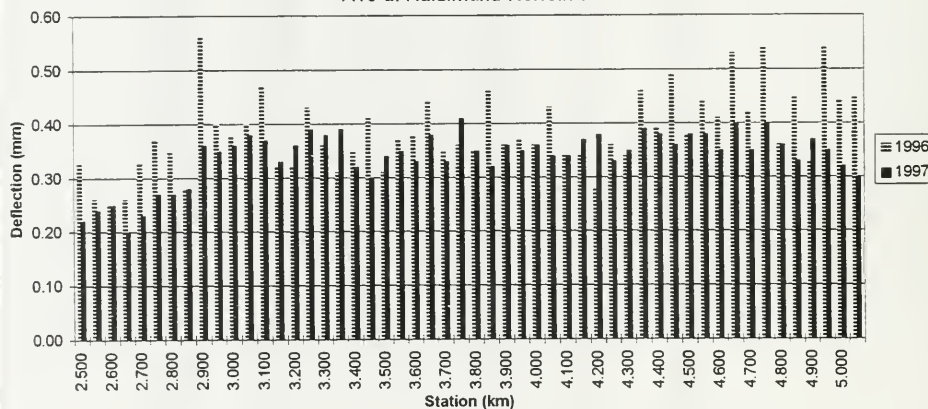
Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)		Pavement Surface Modulus (MPa)	
		1996	1997	1996	1997
2.250	SBL	0.33	0.25	451	606
2.300	NBL	0.32	0.26	468	562
2.350	SBL	0.31	0.27	485	553
2.400	NBL	0.26	0.24	563	628
2.450	SBL	0.26	0.23	578	657
2.500	NBL	0.33	0.22	448	673
2.550	SBL	0.26	0.24	566	610
2.600	NBL	0.25	0.25	605	586
2.650	SBL	0.26	0.20	568	744
2.700	NBL	0.33	0.23	453	651
2.750	SBL	0.37	0.27	403	548
2.800	NBL	0.35	0.27	430	547
2.850	SBL	0.28	0.28	533	532
2.900	NBL	0.56	0.36	264	419
2.950	SBL	0.40	0.35	373	426
3.000	NBL	0.38	0.36	388	418
3.050	SBL	0.40	0.38	369	390
3.100	NBL	0.47	0.37	316	404
3.150	SBL	0.32	0.33	465	445
3.200	NBL	0.32	0.36	471	419
3.250	SBL	0.43	0.39	345	385
3.300	NBL	0.36	0.38	411	390
3.350	SBL	0.31	0.39	473	386
3.400	NBL	0.35	0.32	426	460
3.450	SBL	0.41	0.30	367	499
3.500	NBL	0.31	0.34	487	442
3.550	SBL	0.37	0.35	403	428
3.600	NBL	0.38	0.33	389	455
3.650	SBL	0.44	0.38	337	388
3.700	NBL	0.35	0.33	430	455
3.750	SBL	0.36	0.41	418	363
3.800	NBL	0.35	0.35	421	430
3.850	SBL	0.46	0.32	322	473
3.900	NBL	0.36	0.36	414	416
3.950	SBL	0.37	0.35	403	431
4.000	NBL	0.36	0.36	411	417
4.050	SBL	0.43	0.34	348	439
4.100	NBL	0.34	0.34	436	434
4.150	SBL	0.34	0.37	443	401
4.200	NBL	0.28	0.38	529	388
4.250	SBL	0.36	0.33	415	446
4.300	NBL	0.34	0.35	441	422
4.350	SBL	0.46	0.39	323	383
4.400	NBL	0.39	0.38	377	393
4.450	SBL	0.49	0.36	304	412
4.500	NBL	0.38	0.38	391	390
4.550	SBL	0.44	0.38	338	393
4.600	NBL	0.41	0.35	362	426
4.650	SBL	0.53	0.40	281	370

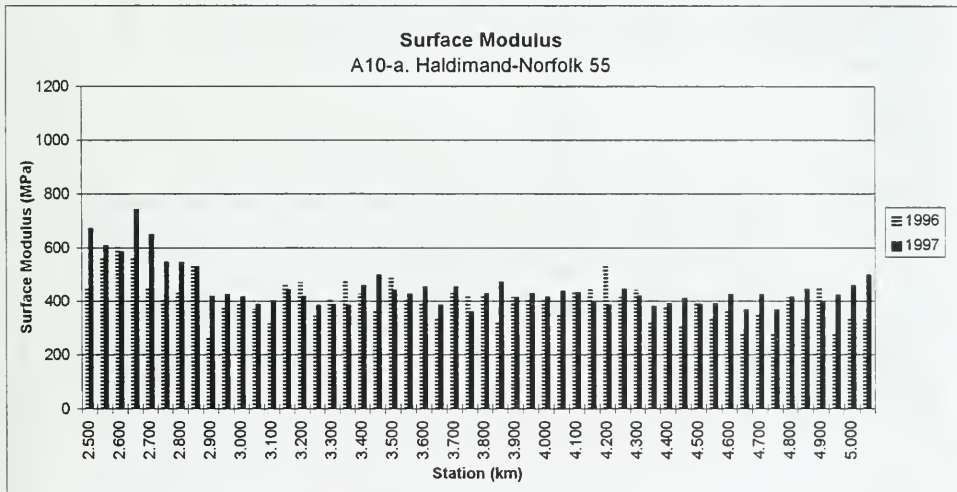
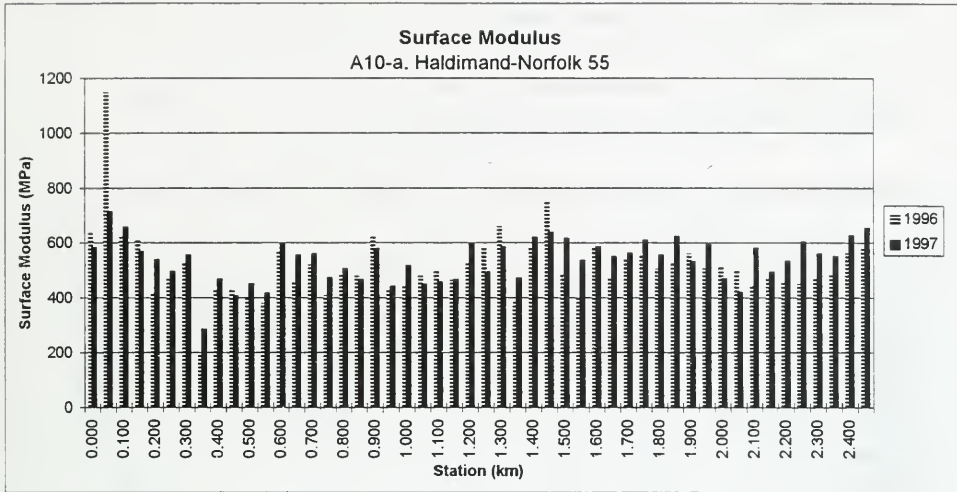
Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)		Pavement Surface Modulus (MPa)	
		1996	1997	1996	1997
4.700	NBL	0.42	0.35	352	427
4.750	SBL	0.54	0.40	275	369
4.800	NBL	0.36	0.36	415	418
4.850	SBL	0.45	0.33	330	446
4.900	NBL	0.33	0.37	452	398
4.950	SBL	0.54	0.35	278	425
5.000	NBL	0.44	0.32	340	461
5.050	SBL	0.45	0.30	330	499
Mean		0.34	0.31	456	494
Standard Deviation		0.08	0.06	119	91.4
Coefficient of Variation		22.3	18.1	26.0	18.5

FWD Deflection
A10-a. Haldimand-Norfolk 55



FWD Deflection
A10-a. Haldimand-Norfolk 55





A10-b. Haldimand-Norfolk Regional Road 9

Location: Villa Nova to Regional Road 70, 3.3 km.

Construction Date: October 31-November 3, 1990

Distress Summary:

Distress Type	Year					
	1996			1997		
	Low	Moderate	High	Low	Moderate	High
Longitudinal (m)	164	7	0	2374	7	0
Transverse (m)	478	106	0	503	108	0
Construction Joint (m)	2724	50	0	2724	50	0
Meandering (m)	0	23	0	5	23	0
Alligator (m ²)	53	0	0	90	22	0
Edge (m)	0	0	0	0	0	0
Ravelling (m ²)	5	0	0	3	0	0
Patching (m ²)	5	0	0	10	0	0
Potholes	1	0	0	0	0	0
PCI	84			83		

Comments: In generally fair condition. Low to moderate construction joint cracking is evident along almost the entire length.

Localized areas have more severe cracking and ravelling.

Some ravelled areas were patched, resulting in lower number in 1997.

Rubber Modified Asphalt Detailed Pavement Monitoring Sections
 A10b. Haldimand Norfolk Regional Road 9 from Villa Nova to Regional Road 70

Detailed Pavement Distresses for 1996*

Station	Pavement Distress Type														Remarks
	Cracks														
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)	Patching (m ²)	
0+000 to 0+100	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Low		
0+100 to 0+200	13	4			34	8			4	3	100				
0+200 to 0+300	1.5	2.5				4					100				
0+300 to 0+400	5					6			1		100				
0+400 to 0+500	6	3.5				6			3		94				
0+500 to 0+600	5	5		2							100				
0+600 to 0+700	12	2			7	6					100				
0+700 to 0+800	5			21		6			4		100				
0+800 to 0+900	1					6					100				
0+900 to 1+000	5								3		100				
1+000 to 1+100					26				2		100				
1+100 to 1+200	8								7		50	50			
1+200 to 1+300	8	3							1		39				
1+300 to 1+400	2								4						
1+400 to 1+500	3				3						12				
1+500 to 1+600	6	3.5			8				7		100				
1+600 to 1+700	2				10				9		100				
1+700 to 1+800	25				10				1		61				
1+800 to 1+900	33	14									86				
1+900 to 2+000	39	8									96				
2+000 to 2+100	43	10									65				
2+100 to 2+200	37	13							3		49				
2+200 to 2+300	48	7									100				
2+300 to 2+400					28						48				
2+400 to 2+500	10	7			7				1		90				
2+500 to 2+600	6										100		5	5	
2+600 to 2+700	19										94				
2+700 to 2+800	40										100				
2+800 to 2+900	18										100				
2+900 to 3+000	11	3.5									91				
3+000 to 3+100	17	3.5									69				
3+100 to 3+200	23				2						100				
3+200 to 3+298	29	13									80				
Total, 1996	Transverse		Meandering		Longitudinal		Edge		Alligator		Construction Joint		Ravelling		Patching
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Low
	478	106	0	0	23	164	7	0	0	53	0	2724	50	5	5
															1 Pothole

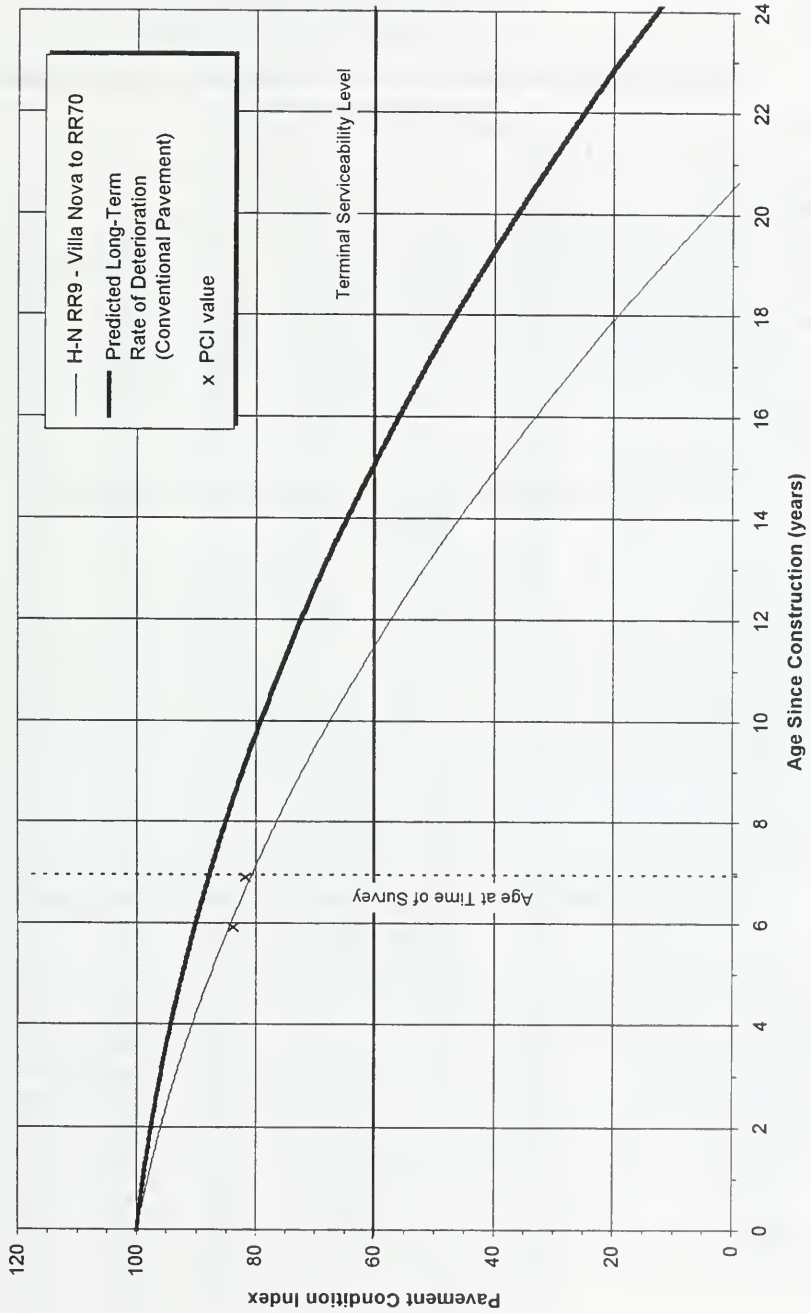
Note: * Refer to Pavement Inspection Forms for distress locations.

Detailed Pavement Distresses for 1997*

Detailed Pavement Distresses for 1897*										Station	Pavement Distress Type										Remarks					
										Station	Cracks										Ravelling (m ²)		Patching (m ²)			
											Transverse (m)				Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)			
											Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	High	
0+000 to 0+100										13	4				128							8		100		
0+100 to 0+200															108						3		100			
0+200 to 0+300										15	2.5				100								100			
0+300 to 0+400										5					104					1			94			
0+400 to 0+500										6	3.5				102					3			100			
0+500 to 0+600										5	5			2	113	7							100			
0+600 to 0+700										12	2				106					4			100			
0+700 to 0+800										5				21	106							100				
0+800 to 0+900										1					106					3			100			
0+900 to 1+000										5					100					2			100			
1+000 to 1+100															126								50			
1+100 to 1+200										8					100					7			39			
1+200 to 1+300										8	3				100				1							
1+300 to 1+400										2					100					4						
1+400 to 1+500											3				103								12			
1+500 to 1+600										6	3.5				110					7			100			
1+600 to 1+700										2					110					9			61			
1+700 to 1+800										25					100					1			86			
1+800 to 1+900										33	14				100							96				
1+900 to 2+000										39	8				100							65				
2+000 to 2+100										43	10				100											
2+100 to 2+200										37	13				100				15			49				
2+200 to 2+300										48	7											100				
2+300 to 2+400															28							48				
2+400 to 2+500										10	7				7				1			90				
2+500 to 2+600										6	2											100				
2+600 to 2+700										22												94				
2+700 to 2+800										42									12			100				
2+800 to 2+900										20									1			100				
2+900 to 3+000										13	3.5				3				4			91				
3+000 to 3+100										24	3.5				3							69				
3+100 to 3+200										29					3							100				
3+200 to 3+298										32	13			5								80				
Total, 1997										503	108	0	5	23	2374	7	0	0	90	22	2724	50	3	10		

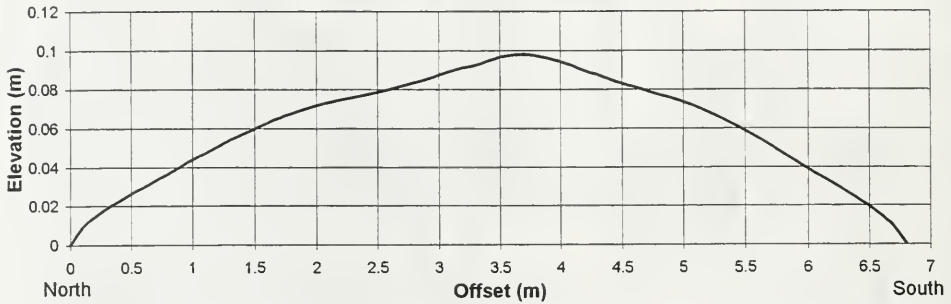
Note: * Refer to Pavement Inspection Forms for distress locations.

Pavement Life-Cycle Modelling
A10-b. Haldimand Norfolk R.R. 9 - Villa Nova to R.R. 70

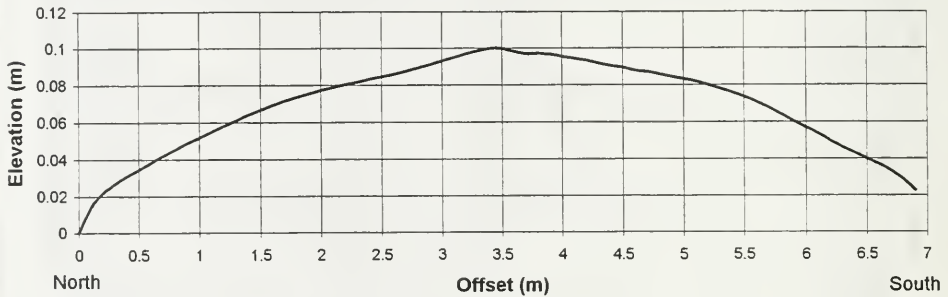


Pavement Profile Measurements

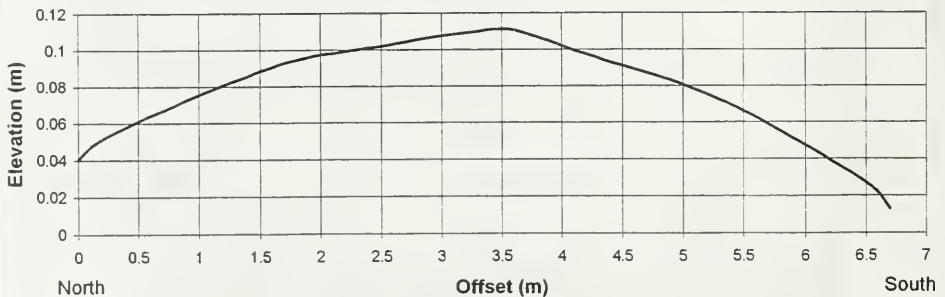
**A10-b. Haldimand-Norfolk Regional Road 9, RR 70 to Villa Nova
Station 0+570**



**A10-b. Haldimand-Norfolk Regional Road 9, RR 70 to Villa Nova
Station 1+610**



**A10-b. Haldimand-Norfolk Regional Road 9, RR 70 to Villa Nova
Station 2+830**

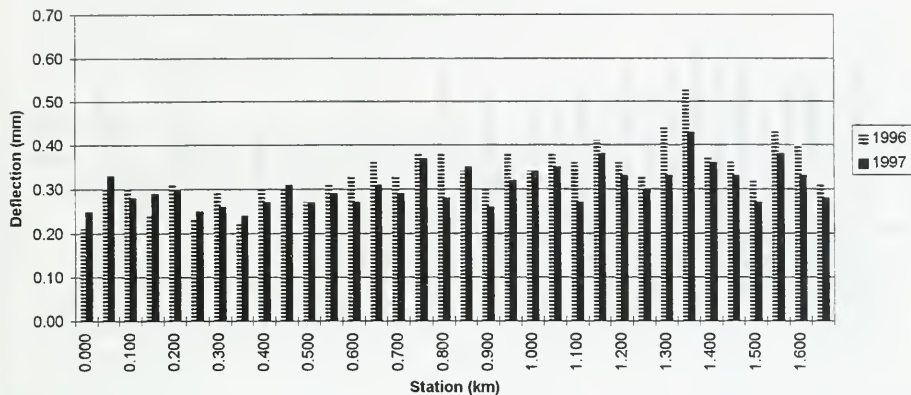


PAVEMENT DEFLECTION ANALYSIS RESULTS
A10-b. HALDIMAND-NORFOLK REGIONAL ROAD 9
Regional Road 70 to Villa Nova

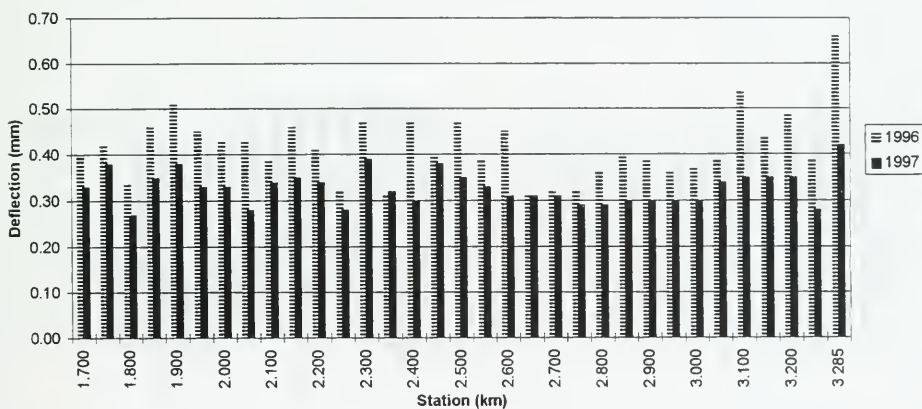
Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)		Pavement Surface Modulus (MPa)	
		1996	1997	1996	1997
0.000	WBL	0.21	0.25	695	595
0.050	EBL	0.30	0.33	489	450
0.100	WBL	0.30	0.28	491	541
0.150	EBL	0.24	0.29	624	514
0.200	WBL	0.31	0.30	483	492
0.250	EBL	0.23	0.25	658	593
0.300	WBL	0.29	0.26	522	575
0.350	EBL	0.22	0.24	672	625
0.400	WBL	0.30	0.27	501	548
0.450	EBL	0.30	0.31	498	473
0.500	WBL	0.27	0.27	555	545
0.550	EBL	0.31	0.29	487	510
0.600	WBL	0.33	0.27	458	544
0.650	EBL	0.36	0.31	410	484
0.700	WBL	0.33	0.29	457	506
0.750	EBL	0.38	0.37	392	404
0.800	WBL	0.38	0.28	394	526
0.850	EBL	0.34	0.35	445	432
0.900	WBL	0.30	0.26	503	572
0.950	EBL	0.38	0.32	392	465
1.000	WBL	0.34	0.34	437	434
1.050	EBL	0.38	0.35	393	430
1.100	WBL	0.36	0.27	418	550
1.150	EBL	0.41	0.38	361	392
1.200	WBL	0.36	0.33	418	447
1.250	EBL	0.33	0.30	455	494
1.300	WBL	0.44	0.33	340	452
1.350	EBL	0.53	0.43	283	350
1.400	WBL	0.37	0.36	406	417
1.450	EBL	0.36	0.33	418	453
1.500	WBL	0.32	0.27	465	562
1.550	EBL	0.43	0.38	349	389
1.600	WBL	0.40	0.33	369	452
1.650	EBL	0.31	0.28	476	529
1.700	WBL	0.40	0.33	376	446
1.750	EBL	0.42	0.38	355	387
1.800	WBL	0.34	0.27	444	559
1.850	EBL	0.46	0.35	326	427
1.900	WBL	0.51	0.38	292	392
1.950	EBL	0.45	0.33	332	456
2.000	WBL	0.43	0.33	350	456
2.050	EBL	0.43	0.28	345	529
2.100	WBL	0.39	0.34	379	436
2.150	EBL	0.46	0.35	324	422
2.200	WBL	0.41	0.34	359	442

Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)		Pavement Surface Modulus (MPa)	
		1996	1997	1996	1997
2.250	EBL	0.32	0.28	467	526
2.300	WBL	0.47	0.39	315	377
2.350	EBL	0.31	0.32	483	470
2.400	WBL	0.47	0.30	316	503
2.450	EBL	0.40	0.38	377	389
2.500	WBL	0.47	0.35	317	425
2.550	EBL	0.39	0.33	382	455
2.600	WBL	0.45	0.31	334	475
2.650	EBL	0.31	0.31	486	477
2.700	WBL	0.32	0.31	467	474
2.750	EBL	0.32	0.29	467	518
2.800	WBL	0.36	0.29	410	510
2.850	EBL	0.40	0.30	375	497
2.900	WBL	0.39	0.30	380	491
2.950	EBL	0.36	0.30	410	493
3.000	WBL	0.37	0.30	403	493
3.050	EBL	0.39	0.34	377	442
3.100	WBL	0.54	0.35	275	421
3.150	EBL	0.44	0.35	338	426
3.200	WBL	0.49	0.35	304	424
3.250	EBL	0.39	0.28	384	527
3.285	WBL	0.66	0.42	224	356
Mean		0.38	0.32	416	476
Standard Deviation		0.08	0.04	92	61.2
Coefficient of Variation		21.4	13.1	22.2	12.9

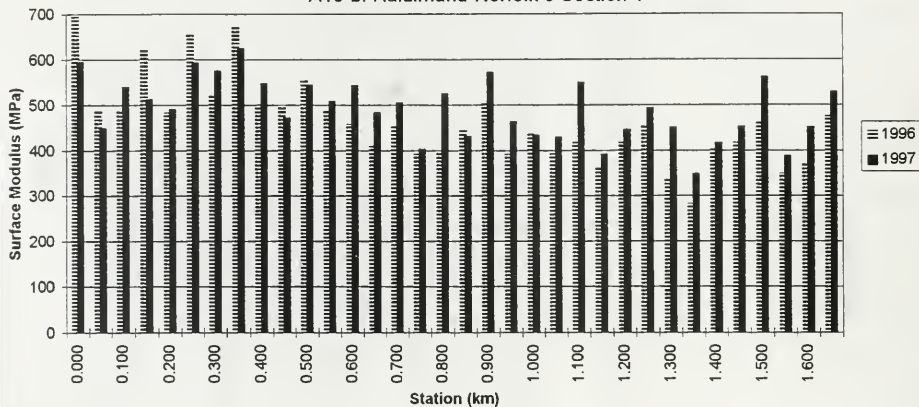
FWD Deflection
A10-b. Haldimand-Norfolk 9 Section 1



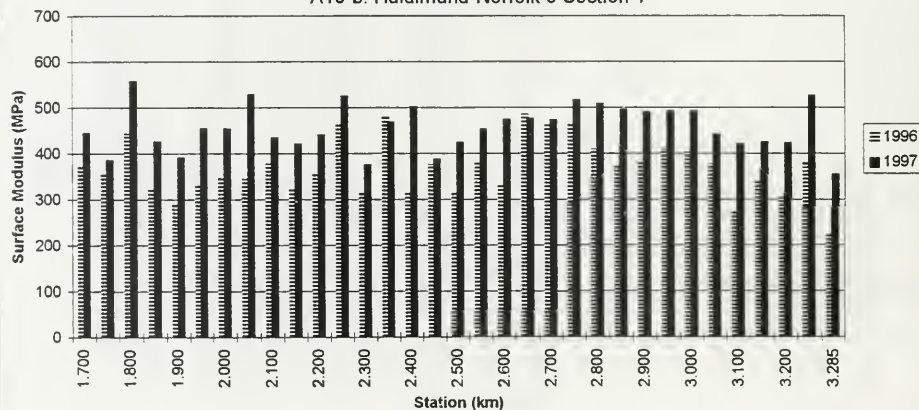
FWD Deflection
A10-b. Haldimand-Norfolk 9 Section 1



Surface Modulus
A10-b. Haldimand-Norfolk 9 Section 1



Surface Modulus
A10-b. Haldimand-Norfolk 9 Section 1



A10-c. Haldimand-Norfolk Regional Road 9

Location: Regional Road 70 to Regional Road 55

Construction Date: October 31-November 3, 1990

Distress Summary:

Distress Type	Year					
	1996			1997		
	Low	Moderate	High	Low	Moderate	High
Longitudinal (m)	791	133	6	798	133	6
Transverse (m)	199	66	28	206	66	28
Construction Joint (m)	110	534	0	110	534	0
Meandering (m)	38	4	0	43	4	0
Alligator (m ²)	1	0	0	1	0	0
Edge (m)	0	0	0	0	0	0
Ravelling (m ²)	0	0	0	0	0	0
Patching (m ²)	1	0	0	1	0	0
Potholes	0	0	0	0	0	0
PCI	71			71		

Comments: In generally fair condition with localized areas of more severe cracking.

Data for A10-a, A10-b, and A10-c:

Contractor: Cayuga Materials & Construction Company Ltd.

CRM Source: Recovery Technologies & Custom Cryogenic, #10 mesh

CRM Amount: 60,000 tire equivalent

Mix: 6,298 tonnes HL 3; 5,153 Tonnes HL 8

Rubber Modified Asphalt Detailed Pavement Monitoring Sections
A10c. Haldimand Norfolk Regional Road 9 from Regional Road 55 to Regional Road 70

Detailed Pavement Distresses for 1996*

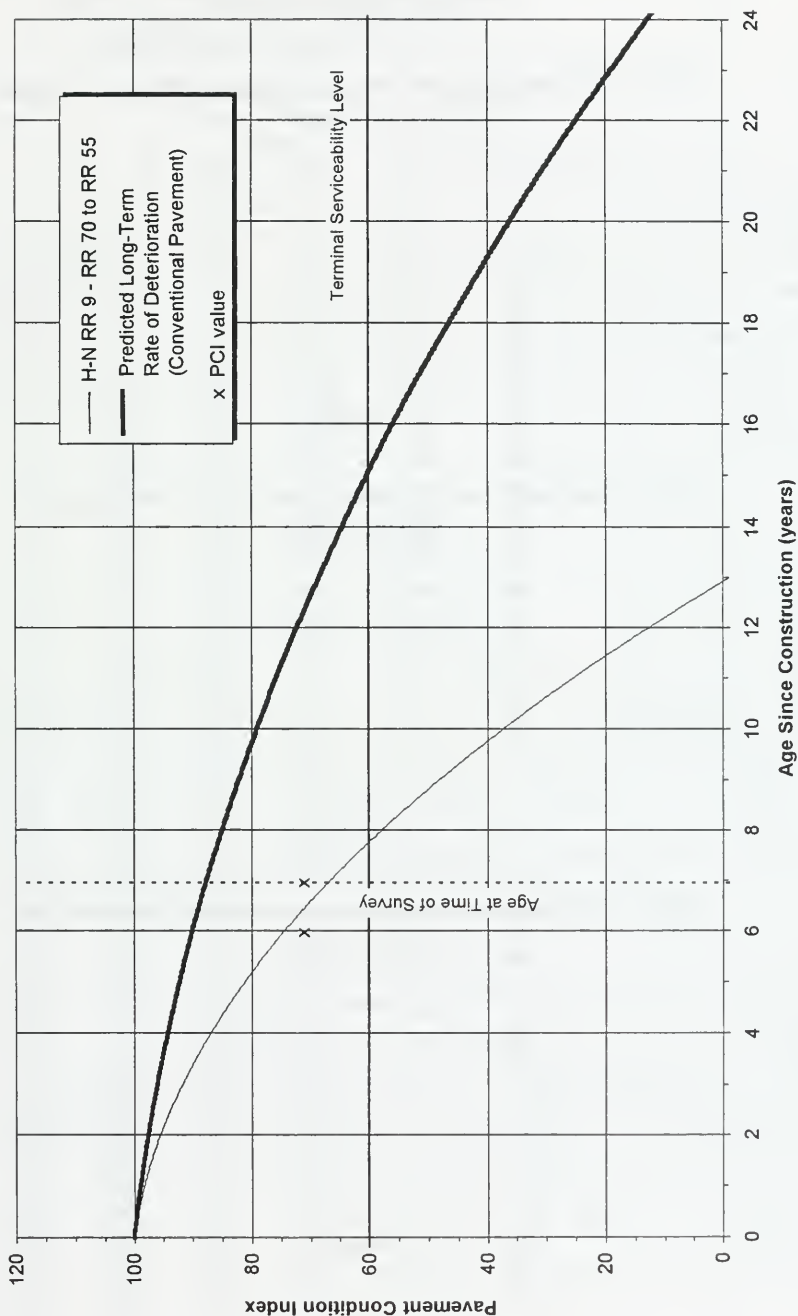
Station	Pavement Distress Type																Remarks				
	Cracks																				
	Transverse (m)			Meandering (m)			Longitudinal (m)			Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)		Patching (m ²)			
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low		Moderate	High	Low	Moderate
0+000 to 0+100	4		7				57									100					
0+100 to 0+200	30	12					38									10	90				
0+200 to 0+300	43	4		6	4		220										100				
0+300 to 0+400	37						204						1				100				
0+400 to 0+500	37	4		12			126	70	6							100					
0+500 to 0+600	23	15	10	20			64										89			1	
0+600 to 0+700	25	31	11				82	63									55	45			
0+700 to 0+800																					
0+800 to 0+900																					
0+900 to 1+000																					
1+000 to 1+100																					
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2+500 to 2+600																					
2+600 to 2+700																					
2+700 to 2+800																					
2+800 to 2+900																					
2+900 to 3+000																					
Total, 1996	199	66	28	38	4		791	133	6	0	0	1	0	1	110	534	45	0	1	1	

Detailed Pavement Distresses for 1997*

Station	Pavement Distress Type																Remarks		
	Cracks																		
	Transverse (m)			Meandering (m)			Longitudinal (m)			Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)		Patching (m ²)	
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	Low	Moderate	High	Low	Moderate		Low	High
0+000 to 0+100	4		7				58								100				
0+100 to 0+200	30	12		5			40								10	90			
0+200 to 0+300	43	4		6	4		220									100			
0+300 to 0+400	37						204						1			100			
0+400 to 0+500	37	4		12			126	70	6							100			
0+500 to 0+600	28	15	10	20			64									89		1	
0+600 to 0+700	27	31	11				86	63								55	45		
0+700 to 0+800																			
0+800 to 0+900																			
0+900 to 1+000																			
1+000 to 1+100																			
1+100 to 1+200																			
1+200 to 1+300																			
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2+400 to 2+500																			
2+500 to 2+600																			
2+600 to 2+700																			
2+700 to 2+800																			
2+800 to 2+900																			
2+900 to 3+000																			
Total, 1997	206	66	28	43	4		798	133	6	0	0	1	0	1	110	534	45	0	1

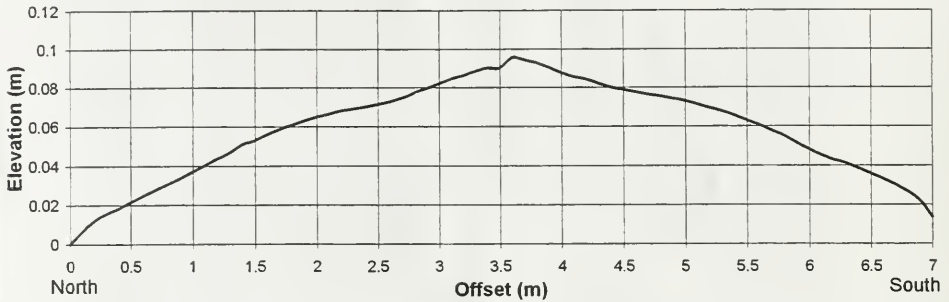
Note: * Refer to Pavement Inspection Forms for distress locations.

Pavement Life-Cycle Modelling A10-c. Haldimand - Norfolk R.R. 9

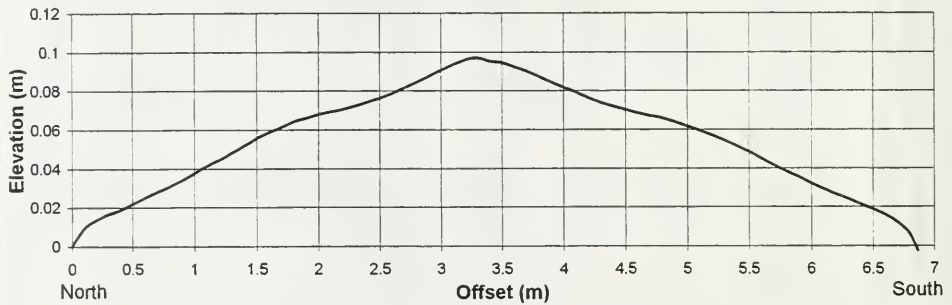


Pavement Profile Measurements

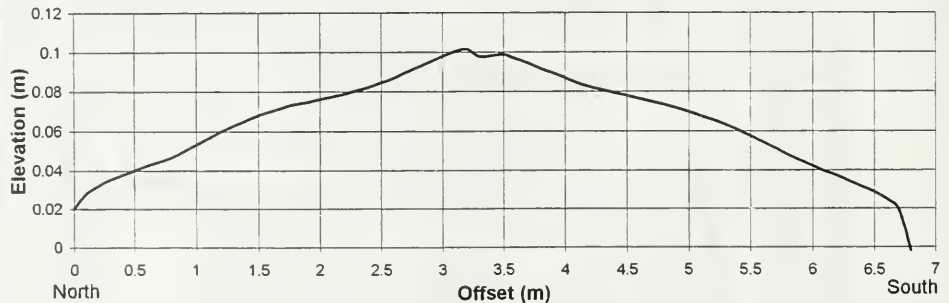
**A10-c. Haldimand-Norfolk Regional Road 9, RR 55 to RR 70
Station 0+370**



**A10-c. Haldimand-Norfolk Regional Road 9, RR 55 to RR 70
Station 1+150**



**A10-c. Haldimand-Norfolk Regional Road 9, RR 55 to RR 70
Station 2+369**

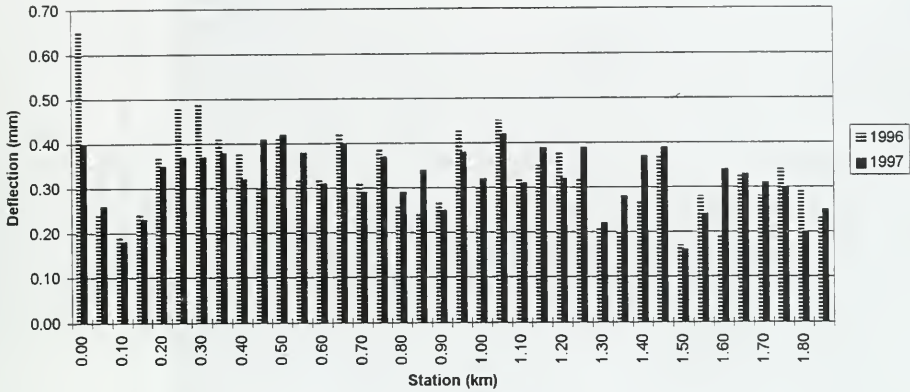


PAVEMENT DEFLECTION ANALYSIS RESULTS
A10-c. HALDIMAND-NORFOLK REGIONAL ROAD 9
Regional Road 55 to Regional Road 70

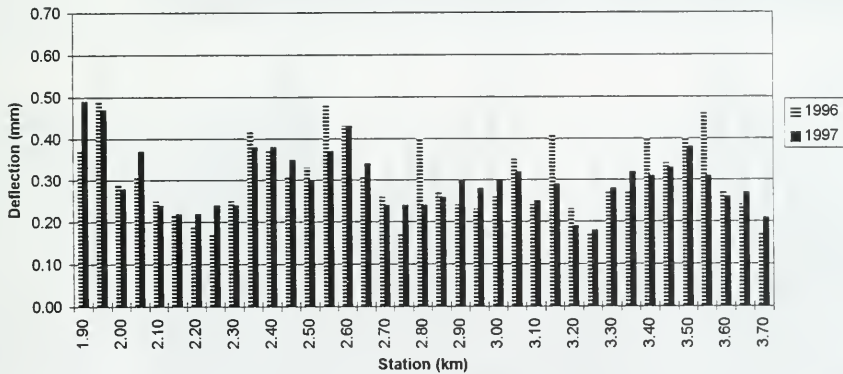
Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)		Pavement Surface Modulus (MPa)	
		1996	1997	1996	1997
0.00	WBL	0.65	0.40	229	368
0.05	EBL	0.24	0.26	632	565
0.10	WBL	0.19	0.18	803	808
0.15	EBL	0.24	0.23	627	643
0.20	WBL	0.37	0.35	397	426
0.25	EBL	0.48	0.37	313	399
0.30	WBL	0.49	0.37	301	401
0.35	EBL	0.41	0.38	368	391
0.40	WBL	0.38	0.32	388	468
0.45	EBL	0.30	0.41	495	365
0.50	WBL	0.41	0.42	365	356
0.55	EBL	0.32	0.38	466	390
0.60	WBL	0.32	0.31	469	484
0.65	EBL	0.42	0.40	352	374
0.70	WBL	0.31	0.29	476	518
0.75	EBL	0.39	0.37	384	398
0.80	WBL	0.26	0.29	568	514
0.85	EBL	0.24	0.34	621	432
0.90	WBL	0.27	0.25	549	589
0.95	EBL	0.43	0.38	343	389
1.00	WBL	0.30	0.32	505	469
1.05	EBL	0.45	0.42	329	352
1.10	WBL	0.32	0.31	464	475
1.15	EBL	0.35	0.39	423	380
1.20	WBL	0.38	0.32	387	464
1.25	EBL	0.32	0.39	472	380
1.30	WBL	0.21	0.22	726	675
1.35	EBL	0.20	0.28	746	538
1.40	WBL	0.27	0.37	545	401
1.45	EBL	0.37	0.39	404	380
1.50	WBL	0.17	0.16	874	960
1.55	EBL	0.28	0.24	539	630
1.60	WBL	0.19	0.34	781	434
1.65	EBL	0.33	0.33	448	452
1.70	WBL	0.28	0.31	525	477
1.75	EBL	0.34	0.30	438	492
1.80	WBL	0.29	0.20	518	756
1.85	EBL	0.23	0.25	641	600
1.90	WBL	0.37	0.49	400	305
1.95	EBL	0.49	0.47	303	314
2.00	WBL	0.29	0.28	506	539
2.05	EBL	0.31	0.37	484	406
2.10	WBL	0.25	0.24	590	609
2.15	EBL	0.22	0.22	674	683
2.20	WBL	0.19	0.22	792	668

Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)		Pavement Surface Modulus (MPa)	
		1996	1997	1996	1997
2.25	EBL	0.17	0.24	861	610
2.30	WBL	0.25	0.24	590	623
2.35	EBL	0.42	0.38	354	390
2.40	WBL	0.37	0.38	404	389
2.45	EBL	0.31	0.35	477	430
2.50	WBL	0.33	0.30	448	502
2.55	EBL	0.48	0.37	310	401
2.60	WBL	0.43	0.43	349	347
2.65	EBL	0.31	0.34	482	442
2.70	WBL	0.26	0.24	573	614
2.75	EBL	0.17	0.24	902	623
2.80	WBL	0.40	0.24	369	622
2.85	EBL	0.27	0.26	548	583
2.90	WBL	0.24	0.30	631	504
2.95	EBL	0.23	0.28	654	536
3.00	WBL	0.26	0.30	564	497
3.05	EBL	0.35	0.32	425	468
3.10	WBL	0.24	0.25	618	592
3.15	EBL	0.41	0.29	368	511
3.20	WBL	0.23	0.19	654	765
3.25	EBL	0.17	0.18	888	809
3.30	WBL	0.27	0.28	555	539
3.35	EBL	0.27	0.32	555	470
3.40	WBL	0.40	0.31	373	479
3.45	EBL	0.34	0.33	438	453
3.50	WBL	0.40	0.38	374	396
3.55	EBL	0.46	0.31	325	476
3.60	WBL	0.27	0.26	548	563
3.65	EBL	0.24	0.27	622	553
3.70	WBL	0.17	0.21	889	709
Mean		0.32	0.31	517	507
Standard Deviation		0.10	0.07	160	129
Coefficient of Variation		30.2	23.1	31.0	25.5

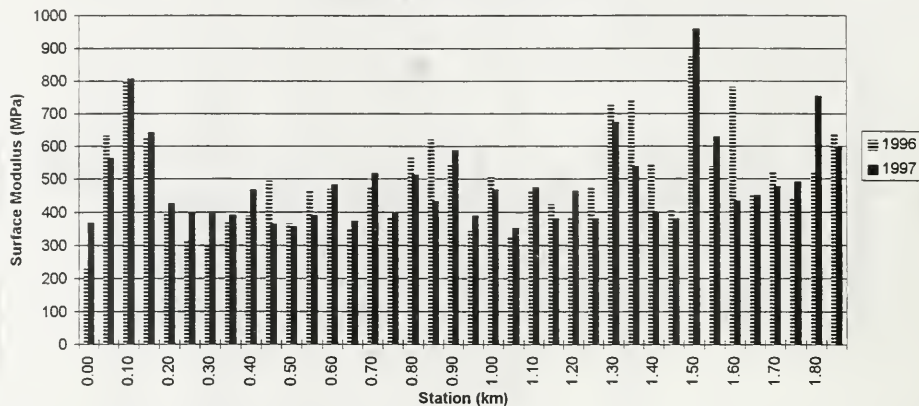
FWD Deflection
A10-c. Haldimand-Norfolk 9 Section 2



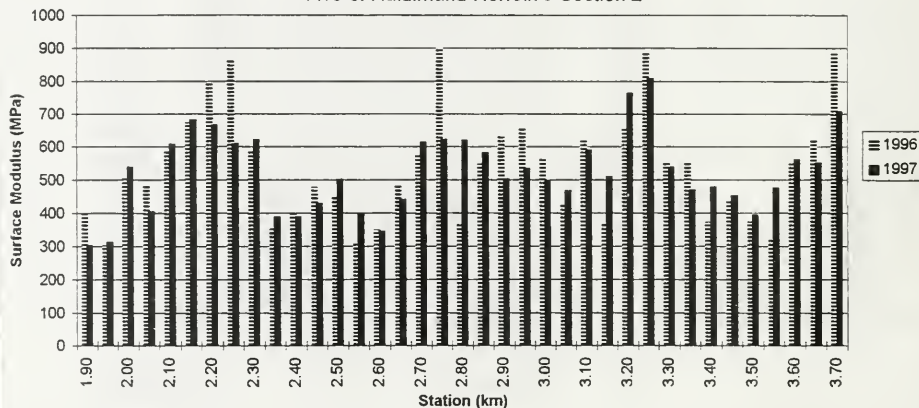
FWD Deflection
A10-c. Haldimand-Norfolk 9 Section 2



Surface Modulus
A10-c. Haldimand-Norfolk 9 Section 2



Surface Modulus
A10-c. Haldimand-Norfolk 9 Section 2



1996
Photograph A10-1a
Station 2+500,
looking west at Dry
Process RMA.
[05/28/96, SR]



1997
Photograph A10-1b
Station 2+500.
[07/15/97, PP]



Photograph A10-1 Haldimand-Norfolk Regional Road 9 Section 1 (Villa Nova to RR 70) at Station 2+500 from west project limit. Localized area of ravelling and potholes has deteriorated requiring more extensive patching in 1997.

1996

Photograph A10-2a
Station 0+770 from
west project limit.
[05/28/96. SR]



1997

Photograph A10-2b
Station 0+770 from
west project limit.
[05/24/97, PP]



Photograph A10-2 Haldimand-Norfolk Regional Road 9 Section 1 (1990 section. Dry Process).
Cracking shows little change from 1996, top.

1996
Photograph A10-3a
Station 1+500,
southbound lane of
Dry Process RMA.
[05/28/96, SR]



1997
Photograph A10-3b
Station 1+500, same
view as above.
[05/24/97, PP]



Photograph A10-3 Haldimand Norfolk Regional Road 55 (1990 section, Dry Process). Spray patching has had additional minor repair since 1996.

1996



Photograph A10-4 Haldimand Norfolk Regional Road 55 at Station 4+500 from south project limit. Typical moderate severity longitudinal and construction joint cracking.

[05/28/96, SR]

1997



Photograph A10-5 Haldimand Norfolk Regional Road 55 at Station 4+470 from south project limit, looking north at longitudinal cracking in northbound lane.

[05/24/97, PP]

A11. Highway 400

Location: 5.5 km north of Highway 89, 325 m.

Construction Date: July 24, 1990

Contractor: Allan G. Cook Construction Company Ltd.

CRM Source: Rouse Rubber Industries Inc., #80 mesh

Comments: In generally good condition with transverse cracking at regular intervals (20-25 m). See MTO report PAV-95-01 and PAV-91-03 for distress summary.

A12. City of Brantford - Park Road North

Location: Dunsdon Street to Powerline Road, 0.5 km.

Construction Date: October 4-5, 1994

Contractor: TCG Materials

CRM: 15% #40-#60 mesh CRM (Duratirephalt)

Distress Summary:

Distress Type	1996			1997		
	Low	Moderate	High	Low	Moderate	High
Longitudinal (m)	0	0	0	655	0	0
Transverse (m)	7	0	0	49	0	0
Construction Joint (m)	0	0	0	300	0	0
Meandering (m)	0	0	0	14	0	0
Alligator (m ²)	0	0	0	0	0	0
Edge (m)	0	0	0	0	0	0
Ravelling (m ²)	0	0	0	6	0	0
Patching (m ²)	0	0	0	0	0	0
Potholes	0	0	0	0	0	0
PCI	99			85		

Comments: All 1997 cracking is sealed.

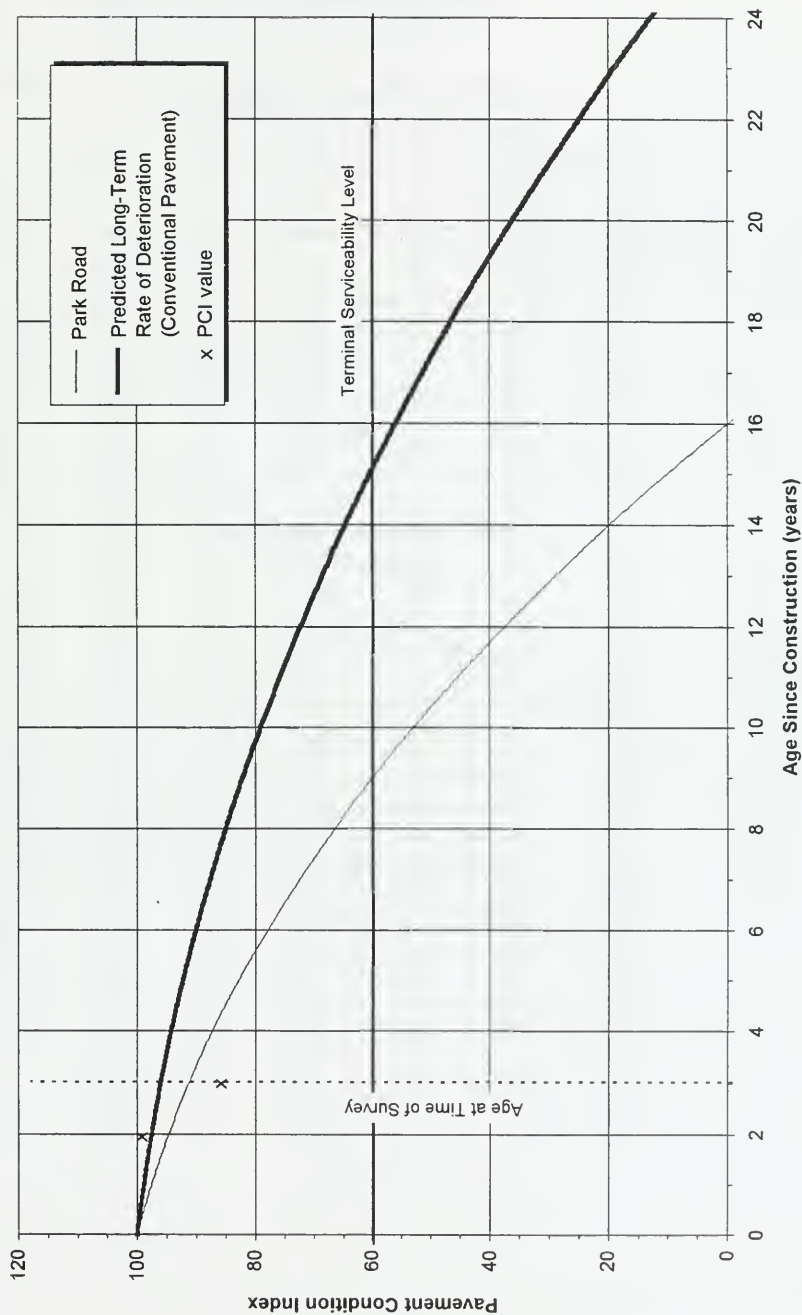
[illegible]

A12. Brantford - Park Road from Power Line Road to Dunsdon Street

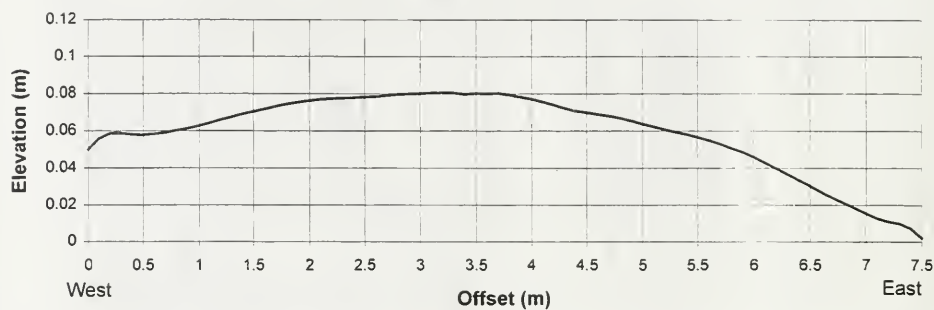
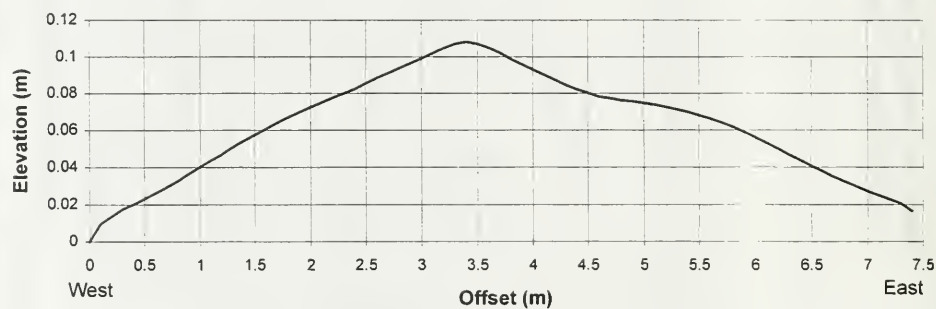
Detailed Pavement Distresses for 1997

Station	Pavement Distress Type														Remarks		
	Cracks																
	Transverse (m)		Meandering (m)		Longitudinal (m)		Edge (m)		Alligator (m ²)		Construction Joint (m)		Ravelling (m ²)		Patching (m ²)		
	Low	Moderate	High	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	Low	Moderate
0+000																	NB
0+006						7											SB
0+012												112					CENTRE
0+022						47											SB
0+069	7																SB
0+080						54											SB
0+111						53											NB
0+156						125											CENTRE
0+171						183											SB
0+267						104											NB
0+291	7																NB
0+291												65					CENTRE
0+292	7																CENTRE
0+364						82											SB
0+380												123					CENTRE
0+380	7																SB
0+416				14													NB
0+418	7																SB
0+437	7																SB
0+475	7																SB
Total, 1996	Low	Transverse		High	Meandering		Longitudinal	Edge		Alligator		Construction Joint		Ravelling		Patching	
	49	0	0	14	0	655	0	0	0	0	0	300	0	6	Low	Low	0

Pavement Life-Cycle Modelling A12. Park Road - Brantford



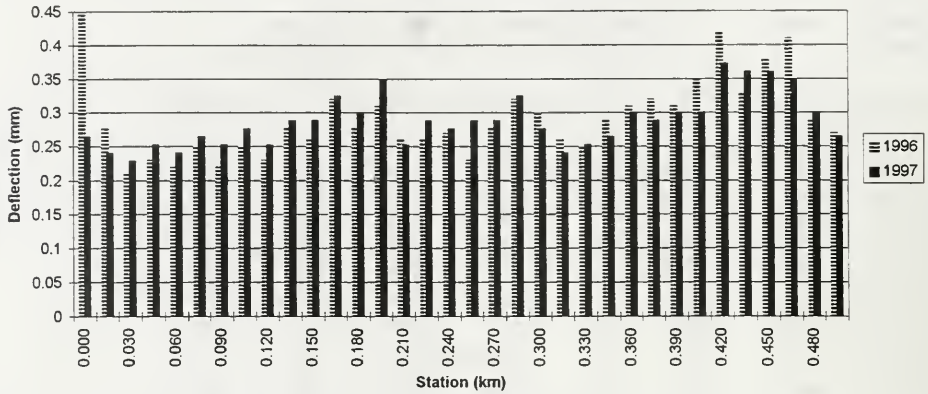
Pavement Profile Measurements

A12. Park Road - Brantford
Station 0+012**A12. Park Road - Brantford**
Station 0+132

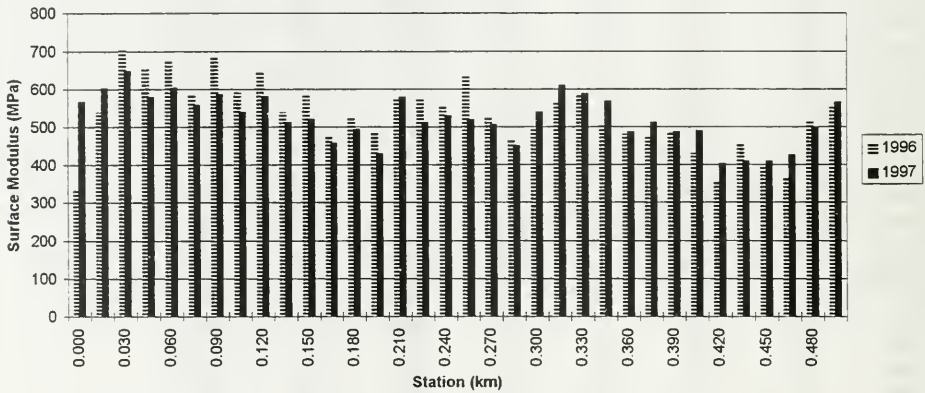
PAVEMENT DEFLECTION ANALYSIS RESULTS
A12. PARK ROAD NORTH, BRANTFORD
Dunsdon Street to Power Line Road

Station (km)	Lane	Normalized FWD Dynamic Deflection (mm)			Pavement Surface Modulus (MPa)		
		1996	1997	97-Adj.	1996	1997	97-Adj.
0.000	NBL	0.45	0.22	0.27	334	684	568
0.015	SBL	0.28	0.20	0.24	539	728	604
0.030	NBL	0.21	0.19	0.23	708	783	650
0.045	SBL	0.23	0.21	0.25	658	699	580
0.060	NBL	0.22	0.20	0.24	675	730	606
0.075	SBL	0.25	0.22	0.27	587	673	559
0.090	NBL	0.22	0.21	0.25	684	708	588
0.105	SBL	0.25	0.23	0.28	592	651	540
0.120	NBL	0.23	0.21	0.25	646	700	581
0.135	SBL	0.28	0.24	0.29	539	619	514
0.150	NBL	0.26	0.24	0.29	583	628	521
0.165	SBL	0.32	0.27	0.33	472	551	457
0.180	NBL	0.28	0.25	0.30	528	596	495
0.195	SBL	0.31	0.29	0.35	487	518	430
0.210	NBL	0.26	0.21	0.25	575	699	580
0.225	SBL	0.26	0.24	0.29	576	617	512
0.240	NBL	0.27	0.23	0.28	558	639	530
0.255	SBL	0.23	0.24	0.29	634	626	520
0.270	NBL	0.28	0.24	0.29	527	610	506
0.285	SBL	0.32	0.27	0.33	464	543	451
0.300	NBL	0.3	0.23	0.28	494	651	540
0.315	SBL	0.26	0.20	0.24	563	735	610
0.330	NBL	0.25	0.21	0.25	587	709	588
0.345	SBL	0.29	0.22	0.27	506	686	569
0.360	NBL	0.31	0.25	0.30	480	587	487
0.375	SBL	0.32	0.24	0.29	471	618	513
0.390	NBL	0.31	0.25	0.30	487	587	487
0.405	SBL	0.35	0.25	0.30	430	590	490
0.420	NBL	0.42	0.31	0.37	355	485	403
0.435	SBL	0.33	0.30	0.36	457	493	409
0.450	NBL	0.38	0.30	0.36	392	493	409
0.465	SBL	0.41	0.29	0.35	365	513	426
0.480	NBL	0.29	0.25	0.30	513	602	500
0.495	SBL	0.27	0.22	0.27	551	682	566
Mean		0.29	0.24	0.29	530	630	523
Standard Deviation		0.06	0.03	0.04	93	78	64
Coefficient of Variation		19.9	13.2	13.2	17.6	12.3	12.3

FWD Deflection
A12. Park Road - Brantford



Surface Modulus
A12. Park Road - Brantford



1996
 Photograph A12-1
 Station 0+000, north
 project limit.
 [05/16/96, SR]



1997
 Photograph A12-2
 Station 0+060 from north project
 limit. Crack sealing applied in 1996
 is coming out of cracks.
 [05/24/97, PP]



Photographs A12-1 and A12-2
 City of Brantford - Park Road North
 Only notable distress in 1996 was small
 transverse crack (see Photograph A12-3).
 Frequent crack sealing performed in
 1997.

1996



Photograph A12-3 City of Brantford - Park Road North at Station 0+292. Low severity transverse crack in northbound lane. [05/16/96, SR]

1997



Photograph A12-4
City of Brantford - Park Road North at
Station 0+060 from north project limit.
Crack sealing in northbound lane.
[05/24/97, PP]

APPENDIX B



B1. Highway 65/Whitewood Avenue, New Liskeard

Location: Ontario Northland Railway to western town limit, 0.76 km.

Construction Date: July 26-29, 1993

Contractor: Helmer Pedersen Construction Ltd.

Mix: 1900 tonnes HL 4

Comments: There is an urban section 260 m long and a rural section 500 m long. The urban section has curb and gutter and parking lanes paved with RMA. The driving lane has a conventional surface course and RMA binder course. The rural section is all RMA. There is localized wheel path ravelling and some crumb rubber has become dislodged from the surface and is noticeable in the gutter.

1996
Photograph B1-1a
Transverse crack just
west of Golding
Street.
[05/14/96, SR]



1997
Photograph B1-1b
Same crack as above.
[05/24/97, GA]



Photograph B1-1 Town of New Liskeard - Whitewood Avenue Highway 65. Low to moderate severity transverse crack has not changed appreciably since 1996. Note that only the outside, parking lanes have RMA surface course.



1996

Photograph B1-2 Town of New Liskeard - Whitewood Avenue/Highway 65 (1993 section. Dry Process). looking west at High Street. Low to medium severity raveling along wheelpaths. [05/14/96. SR]



1997

Photograph B1-3 Town of New Liskeard - Whitewood Avenue/Highway 65 west of High Street. Low to medium severity raveling in eastbound lane. [07/07/97. PP]

B2. Town of Fort Frances - River Road

Location: Old Shambles Road to Biddeson Avenue, 0.25 km.

Construction Date: October 1, 1993

Contractor: Towland-Hewitson Construction Company

Mix: 320 tonnes HL 4 RMA

B3. Town of Fort Frances - Armit Avenue

Location: Scott Street to First Street, 0.09 km.

Mix: 173 tonnes HL 4 RMA

Comments: These two streets are in very good condition with only slight aggregate loss in localized areas.

A third section of RMA was constructed on Colonization Road, which is part of the Trans-Canada Highway. This section failed quickly and had to be removed completely 6 months after construction. The core tests for this section indicated 10.8% air voids, 89.2% compaction, and 5.48% A.C. which are all outside the specified material/construction tolerances.

1996
Photograph B2-1a
Looking north.
[06/03/96, PP]

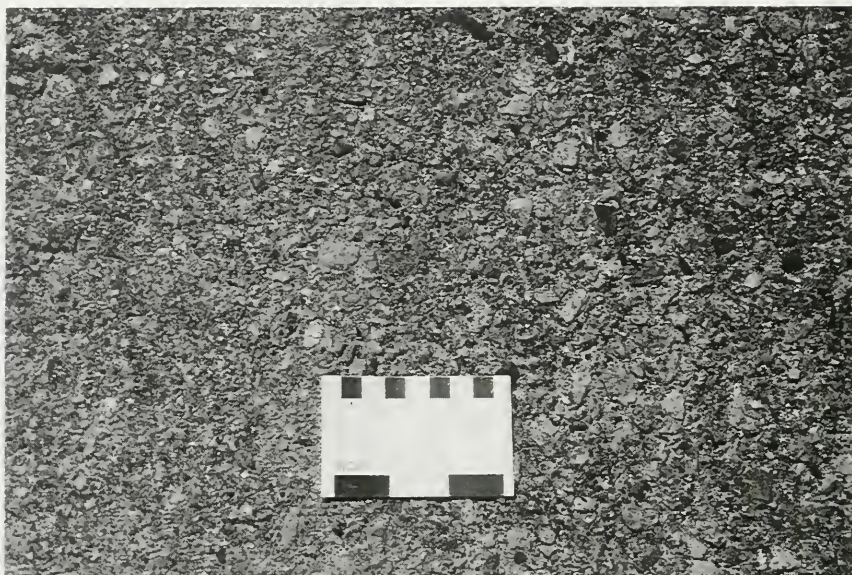


1997
Photograph B2-1b
Looking north.
[07/07/97, PP]



Photograph B2-1 Town of Fort Frances - River Road. Dry Process RMA showing little distress.

1996



Photograph B2-2 Town of Fort Frances - River Road. Close-up of typical pavement appearance.
[06/03/96, PP]

1997



Photograph B2-3 Town of Fort Frances - River Road. Joint at south end of section showing no visible distress.
[07/07/97, PP]

1996
Photograph B3-1a
looking north from
Scott Street.



1997
Photograph B3-1b
looking south at Scott
Street.
[07/07/97. PP]



Photograph B3-1 Town of Fort Frances - Armit Avenue from Scott Street to First Street (1993 section. Dry Process). No distresses are visible.



1996
Photograph B3-2a
looking north at
intersection with
First Street.
[06/03/96, PP]



1997
Photograph B3-2b
Looking south at
same area as above.
[07/07/97, PP]

Photograph B3-2 Town of Fort Frances - Armit Avenue looking south. Note low severity cracking crossing the intersection and slight ravelling in northbound lane.

B4. Barrie Township - Mazinaw Heights Road South

Location: Mazinaw Heights Road South, 1 km.

Construction Date: October 14-15, 1993

Contractor: unknown

CRM: #20/#30 mesh

Comments: This dead end road has low traffic volumes. It is still in good condition with few cracks.

1996



Photograph B4-1a Station 0+400 from north project limit. Moderate severity longitudinal cracking.
[07/18/96, SR]

1997



Photograph B4-1b Barrie Township - Mazinaw Heights Road South. Moderate construction joint and transverse cracking.
[07/18/97, PP]

1996



Photograph B4-3 Barrie Township - Mazinaw Heights Road South at Station 0+500 from north project limit. Transition from RMA (foreground) to conventional hot-mix asphalt (background). [07/18/96. SR]

1997



Photograph B4-4 Barrie Township - Mazinaw Heights Road South at north end. Joint with conventional pavement has some low severity transverse cracking. [07/18/97. PP]

B5. Town of Pelham - Roland Road

Location: From Regional Road 28 to 2.1 km east.

Construction Date: November 10, 1993

Contractor: Economy Paving

Comments: The road is in good condition.



1996
Photograph B5-1a
East project limit.
[05/15/96, SR]



1997
Photograph B5-1b
Same view as above.
[05/12/97, PP]

Photograph B5-1 Town of Pelham - Roland Road (1993 section. Dry Process) at east project limit. Moderate severity construction joint crack, no notable difference from 1996.

1996



Photograph B5-2 Town of Pelham - Roland Road at Station 0+800 from east project limit. Low severity edge cracking extending from the outside wheelpath to the edge of pavement. [05/15/96, SR]

1997



Photograph B5-3 Town of Pelham - Roland Road at Station 1+300. Low severity construction joint and transverse cracks as well as some slight ravelling. [05/12/97, PP]

B6. City of Windsor - Wildwood Dr., Beachdale Rd., Esplanade Dr.

Location: Connecting roads in subdivision near E.C. Row Expressway and Lauzon Parkway, 1.3 km.

Comments: Generally in fair to good condition with minor construction joint cracking and some alligator cracking.

1996
Photograph B6-1a
Esplanade Drive at
Lilac Lane.
[06/09/96. DH]



1997
Photograph B6-1b
Esplanade Drive at
Lilac Lane.
[07/31/97. JM]



Photograph B6-1 City of Windsor - various subdivision streets (1993 section, Dry Process).
Development of alligator cracking can be seen in right wheel path.



1996

Photograph B6-2 City of Windsor - Beachdale Road at Chestnut Drive. Localized low severity construction joint cracking. [06/09/96, DH]



1997

Photograph B6-3 City of Windsor - Wildwood Drive at Forest Glade Drive. Note low severity bump. [07/31/97, JM]

B7. Wellington County Road 2

Location: 4 km east of Highway 9, 2.3 km.

Construction Date: October 15, 18, 1993

B8. Wellington County Road 14

Location: Arthur Sideroad 3 to Highway 89, 3.4 km.

Construction Date: October 12-14, 1993

Contractor: The Murray Group

CRM Source: Recovery Technologies Inc.

CRM: 64 tonnes (12,000 tires), #10 mesh

Comments: Localized areas of severe ravelling have occurred in these two sections, resulting in the formation of potholes. Construction joint cracking is also prevalent. These roads are in generally fair condition.

1996
Photograph B7-1a
Station 0+050, looking
west at RMA in
eastbound lane.
[05/16/96, SR]



1997
Photograph B7-1b
Station 0+020,
looking west.
[05/14/97, PP]



Photograph B7-1. Wellington County Road 2 (1993 section, Dry Process) at west end of project looking west. Note extensive spray patching in both lanes performed since 1996 survey.

1996
Photograph B7-2a
Station 2+300, east
project limit.
[05/16/96. SR]



1997
Photograph B7-2b
Station 2+300, east
project limit.
[05/14/97. PP]



Photograph B7-2 Wellington County Road 2 at 2+300 (east project limit). Entire section has been spray patched since the 1996 survey.

1996
Photograph B8-1a
Station 0-050 from
north project limit.
[05/16/96, SR]



1997
Photograph B8-1b
Station 0-070,
looking north at same
section as above.
[05/14/97, PP]



Photograph B8-1 Wellington County Road 14 near north project limit. Additional patching has been performed on ravelled/potholed pavement in northbound lane.

1996



Photograph B8-2 Wellington County Road 14 at Station 0+600 from the north project limit. Low severity alligator cracking and slight ravelling in southbound lane. [05/16/96. SR]

1997



Photograph B8-3 Wellington County Road 14 at south end joint. Medium severity map cracking with some patching and low severity alligator cracking. [05/14/97. PP]

B9. Port Colborne - Composting Pad

Location: Landfill Site on Elm Street south of Forks Road, 1 ha.

Construction Date: November 22-23, 1993

Contractor: Hard Rock Paving

CRM Source: Custom Cryogenic

CRM: 1.8% in HL 8, 1.64% in HL 3

Comments: Exposed portion of the pad is in excellent condition with no visible cracking.

1996



Photograph B9-1 Port Colborne - Composting Pad (1993 section, Dry Process). [05/15/96, SR]

1997

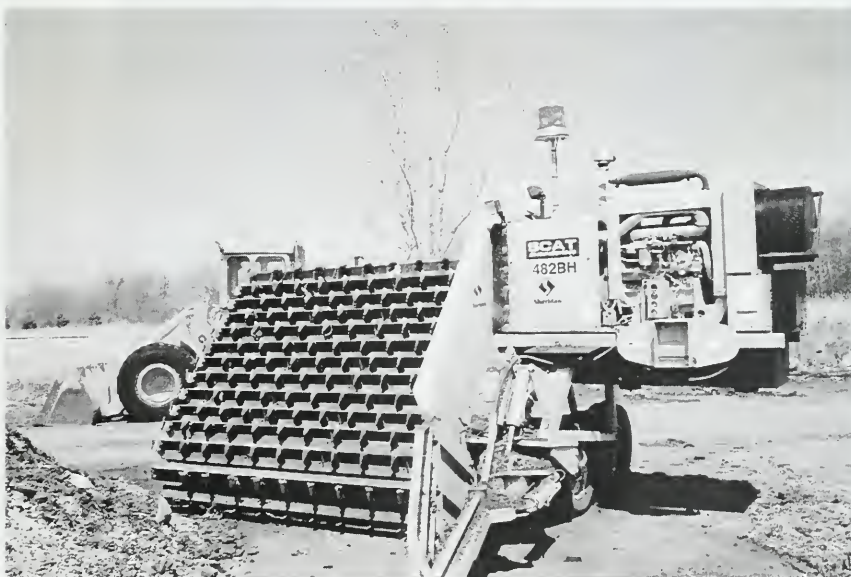


Photograph B9-2 Port Colborne - Composting Pad. Minor raveling caused by the movement of equipment. [05/12/97, PP]



1996

Photograph B9-3 Port Colborne - Composting Pad. [05/15/96, SR]



1997

Photograph B9-4 Port Colborne - Composting Pad. Equipment used at facility. [05/12/97, PP]

B10. City of Cambridge - Stanley Street

Location: Borden Street to Glenmorris Street, 0.5 km.

Construction Date: November 30, 1993

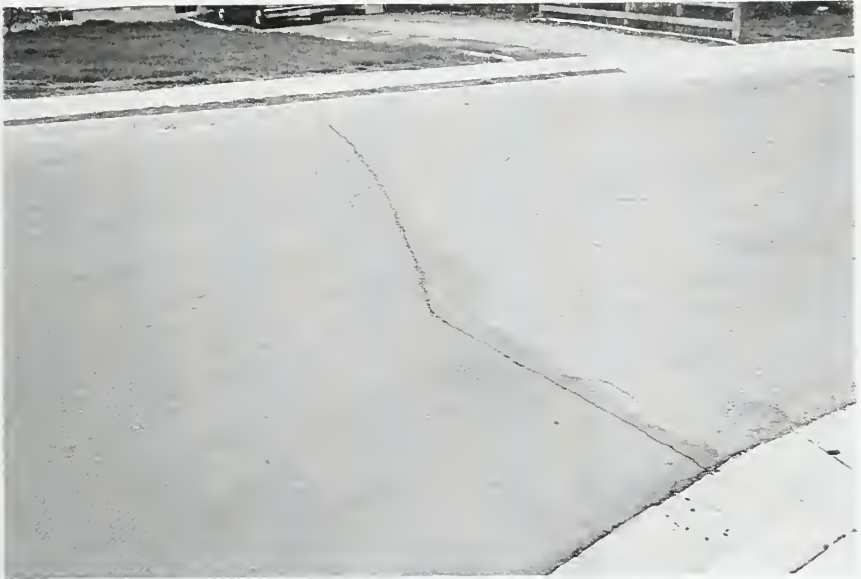
Contractor: Warren Bitulithic

CRM Source: Recovery Technologies

CRM: 1.4%, less than #16 mesh

Mix: 500 tonnes HL 4 base course

Comments: Road is in excellent condition. Only base course is RMA. The surface course, completed in 1994, is conventional asphalt.



1996
Photograph B10-1a
At intersection of
Tait Street.
[05/16/96. SR]



1997
Photograph B10-1b
At intersection of
Tait Street.
[07/17/97. PP]

Photograph B10-1 City of Cambridge - Stanley Street. Low severity construction joint shows little change since 1996. Note surface course is conventional hot-mix asphalt, only binder course is RMA (Dry Process).

1996
Photograph B10-2a
Looking east from
west project limit.
[05/16/96, SR]



1997
Photograph B10-2b
Looking east from
west project limit.
[07/17/97, PP]



Photograph B10-2 City of Cambridge - Stanley Street at west project limit. No significant change since 1996.

B11. Bentinck Township Sideroad 25

Location: From Concession 2 for 3 km north.

Construction Date: October 27-November 2, 1993

Contractor: Seeley and Arnill Aggregates Ltd.

CRM Source: Recovery Technologies

CRM: 1.5%, less than #16 mesh, 8000 tire equivalent

Mix: 40 mm HL 4, 1680 tonnes

Comments: Generally in very good condition with few distresses.

1996
Photograph B11-1a
North project limit
(Station 2+960).
joint with existing
surface treatment.
[05/27/96. MB]

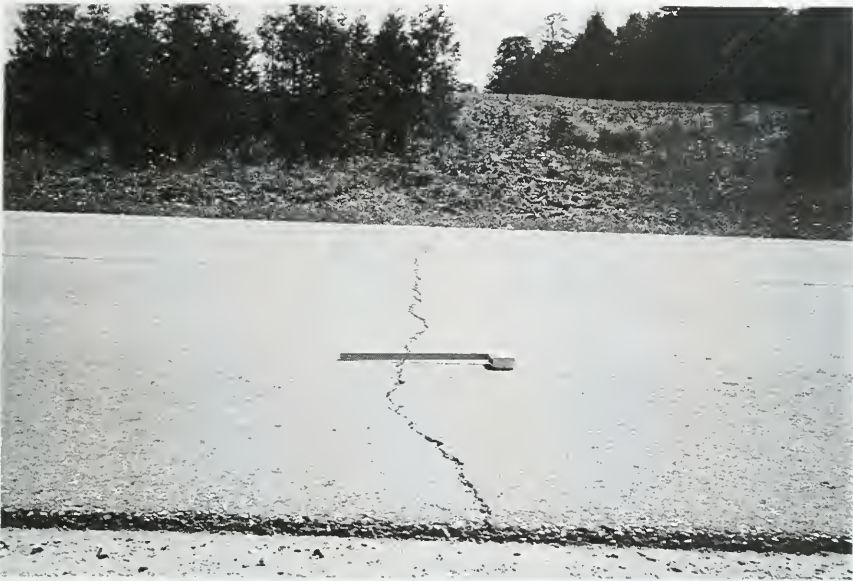


1997
Photograph B11-1b
North project limit
(Station 2+960).
[05/12/97. PP]



Photograph B11-1 Bentinck Township Sideroad 25 at north project limit. No visible difference between 1996 and 1997 condition.

1996



Photograph B11-2 Bentinck Township Sideroad 25 at Station 1+000. Moderate severity transverse crack and slight shoulder drop-off. [05/27/96. MB]

1997



Photograph B11-3 Bentinck Township Sideroad 25 at Station 1+750 looking north. Low severity longitudinal crack. [05/12/97. PP]

B12. Grey County Road 17

Location: Benallen to Copper Kettle.

Comments: Generally in fair to good condition. Road is subject to heavy quarry traffic.

1996
Photograph B12-1a
Station 3+900,
looking south.
[07/02/96, SR]



1997
Photograph B12-1b
Station 3+950,
looking south.
[07/17/97, PP]



Photograph B12-1 Grey County Road 17. Localized low severity edge cracking in northbound lane. Harold Sutherland Construction Limestone Quarry located at Station 2+600 has heavy vehicles using this road.

1996

Photograph B12-2a
Station 0+500 from
south project limit.
[07/02/96, SR]



1997

Photograph B12-2b
Station 0+460 from
south project limit.
[07/17/97, PP]



Photograph B12-2 Grey County Road 17. Low severity alligator cracking near centreline of road.



